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NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

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Use of funds for printing this publication approved by the Director of the Office of Management and Budget March 11, 1971.

INTRODUCTION

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Five indexes are included in each issue: subject, personal author, corporate source, contract number, and report/accession number. Cumulative index volumes are published semiannually and annually.

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By arrangement between NASA and the American Institute of Aeronautics and Astronautics, the AIAA publication *International Aerospace Abstracts (IAA)* provides parallel coverage of scientific and trade journals, books, and conference papers in the same subject areas as *STAR*. *STAR* and *IAA* are categorized and abstracted in basically identical ways, and documents in both are indexed by terms from the *NASA Thesaurus*. Both journals appear twice monthly, *IAA* being issued on the 1st and 15th of each month.

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The Preliminary Edition of the *NASA Thesaurus* (December 1967) (NASA SP-7030) is used as the authority for the indexing vocabulary that appears in the subject index. The *NASA*

Thesaurus should be consulted in examining the current indexing vocabulary, including associated cross-reference structure. Only the subject terms that have been selected to describe the documents abstracted in this issue appear in the subject index. Copies of the *NASA Thesaurus* may be obtained from the National Technical Information Service or the U.S. Government Printing Office at $8.50 for the three-volume set. The first two volumes of this Thesaurus, consisting of the alphabetical listing of subject terms (A–Z), have been superseded by the following single-volume publication: *NASA Thesaurus Alphabetical Update* (September 1971) (NASA SP-7040), available from NTIS for $6.00. (Volume III of the Preliminary Edition consists of the following ancillary aids to vocabulary selection: heirarchical display of index terms, category term listing, permuted index, and a listing of postable terms only.)

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Federal Republic of Germany

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02 Aircraft 429
Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc.; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics.

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Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see specific Physics categories.

11 Facilities, Research and Support 463
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Includes calculation methods and theory; and numerical analysis. For applications see specific categories. For related information see also: 08 Computers.

20 Meteorology 504
Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences.

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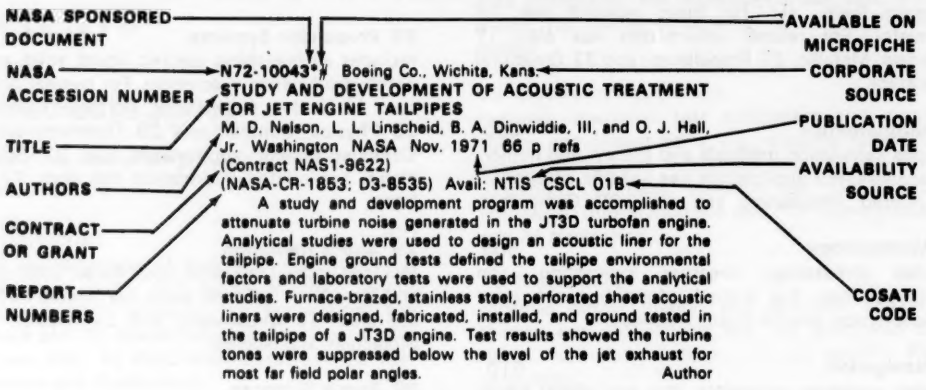
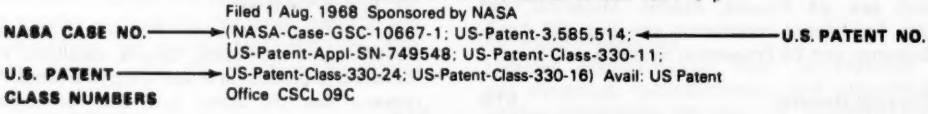


N72-10043*# Boeing Co., Wichita, Kans.
STUDY AND DEVELOPMENT OF ACOUSTIC TREATMENT FOR JET ENGINE TAILPIPES
M. D. Nelson, L. L. Linscheid, B. A. Dinwiddie, III, and O. J. Hall, Jr. Washington NASA Nov. 1971 66 p refs
(Contract NAS1-9622)
(NASA-CR-1853; D3-8535) Avail: NTIS CSCL 01B

A study and development program was accomplished to attenuate turbine noise generated in the JT3D turbofan engine. Analytical studies were used to design an acoustic liner for the tailpipe. Engine ground tests defined the tailpipe environmental factors and laboratory tests were used to support the analytical studies. Furnace-brazed, stainless steel, perforated sheet acoustic liners were designed, fabricated, installed, and ground tested in the tailpipe of a JT3D engine. Test results showed the turbine tones were suppressed below the level of the jet exhaust for most far field polar angles. Author

PATENT CITATION



N71-33129* Collins Radio Co., Cedar Rapids, Iowa.
POWER RESPONSIVE OVERLOAD SENSING CIRCUIT Patent
Arthur P. Kubicz, inventor (to NASA) Issued 15 Jun. 1971 8 p
Filed 1 Aug. 1968 Sponsored by NASA
(NASA-Case-GSC-10667-1; US-Patent-3,585,514; US-Patent-Appl-SN-749548; US-Patent-Class-330-11; US-Patent-Class-330-24; US-Patent-Class-330-16) Avail: US Patent Office CSCL 09C

PATENT APPLICATION CITATION

N72-10432*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
DIATOMIC INFRARED GASDYNAMIC LASER Patent Application
Robert L. McKenzie, inventor (to NASA) Filed 26 Apr. 1971 14 p
(NASA-Case-ARC-10370-1; US-Patent-Appl-SN-137391) Avail: NTIS CSCL 20E

PRIMARY ANALYTIC CITATION AND ABSTRACT

N72-10856*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
THE GEMINI PROGRAM: PHYSICAL SCIENCES EXPERIMENTS SUMMARY
Edward O. Zeitler, comp. and Thomas G. Rogers, comp. (ITT Federal Electric Corp., Houston, Tex.) Sep. 1971 554 p refs
(NASA-TM-X-58075) Avail: NTIS HC $6.00/MF $0.95 CSCL 22C

Results and findings of physical sciences experiments performed in the Gemini program are presented. The summary contains descriptions of selected studies in the fields of astronomy, navigation, radiation, geophysics, meteorology, photography, and communications. For individual titles, see N72-10857 through N72-10891.

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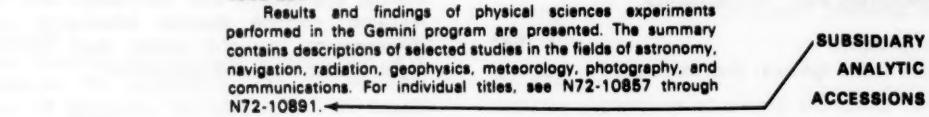
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(See N72-10856 01-30)
Avail: NTIS HC $6.00/MF $0.95 CSCL 14E

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01 AERODYNAMICS

Includes aerodynamics of bodies, combinations, internal flow in ducts and turbo machinery; wings, rotors, and control surfaces. For applications see: 02 Aircraft and 31 Space Vehicles. For related information see also: 12 Fluid Mechanics; and 33 Thermodynamics and Combustion.

N72-12973*# Mithras, Inc., Cambridge, Mass. Aeroscience Dept.

THE AERODYNAMIC CHARACTERISTICS OF LARGE ANGLED CONES WITH RETROROCKETS Final Report, 1 Jun. 1968 - 1 Feb. 1970

Philip O. Jarvinen and Richard H. Adams Feb. 1970 223 p refs

(Contract NAS7-576)

(NASA-CR-124720; MC-70-3001-R2(BNY)) Avail: NTIS CSCL 22B

Analytical and experimental phases of the subject investigation are described. The analytical program for the single jet determines the terminal shock location, the jet boundary, the interface profile, the bow shock profile, the shear layer growth and the dead air region pressure. The experimental program described was conducted over the range from free stream Mach 0.4 to 2.0 at angles-of-attack up to 18 deg and at thrusting coefficients up to C sub T = T/q sub infinity A sub m = 30. Variables investigated included aeroshell angle, number of nozzles, engine thrust, size of nozzles, nozzle throttling and gas composition. The influence of these variables on the aeroshell stability, drag, and loads was determined by integrating pressure measurements on the aeroshell. The total system forces consist of components due to pure thrust and components due to pressure on the aeroshell arising from the jet-free stream interaction. Shadowgraphs provided flow field geometries which proved to be within 10% of those predicted analytically. Author

N72-12974# Weapons Research Establishment, Salisbury (Australia).

DIGITAL COMPUTER CALCULATIONS OF THE EFFECTS OF VARIATION OF MASS AND INERTIA PARAMETERS ON THE SPIN OF A 60 DEG DELTA-WING FIGHTER AIRCRAFT

R. Wilson Jul. 1971 46 p refs

(WRE-TN-453-(WR/D); COSATI-0103; COSATI-2004; RD73) Avail: NTIS

Spinning motions of a 60 deg delta-wing fighter aircraft were obtained by numerically integrating the six degrees of freedom equations of motion on a digital computer. The effects of variation of mass and inertia parameters were studied by comparing perturbed parameter spins with a datum spin while the aerodynamic properties were kept constant. Large and small parameter variations were considered separately, with the small variations being compatible with practical uncertainties in estimates of aircraft mass and inertias, and the large variations being compatible with the carriage of external stores. The effects on computed spins of small parameter variations were not significant. Of the large parameter variations, increasing the rolling moment of inertia was found to be the most practical means of improving spin recovery characteristics. Author

N72-12975*# National Aeronautics and Space Administration. Lewis Researvh Center, Cleveland, Ohio.

COMPUTER PROGRAM FOR DESIGN OF TWO-DIMENSIONAL SUPERSONIC TURBINE ROTOR BLADES WITH BOUNDARY-LAYER CORRECTION

Louis J. Goldman and Vincent J. Scullin Washington Dec. 1971 58 p refs

(NASA-TM-X-2434; E-6494) Avail: NTIS CSCL 20D

A FORTRAN 4 computer program for the design of two-dimensional supersonic rotor blade sections corrected for boundary-layer displacement thickness is presented. The ideal rotor is designed by the method of characteristics to produce vortex flow within the blade passage. The boundary-layer parameters are calculated by Cohen and Reshotoko's method for laminar flow and Sasman and Cresci's method for turbulent flow. The program input consists essentially of the blade surface Mach number distribution and total flow conditions. The primary output is the corrected blade profile and the boundary-layer parameters. Author

N72-12976# Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Goettingen (West Germany).

APOLLO COMMAND MODULE AERODYNAMIC SIMULATION TEST IN HYPERSONIC FLOW

G. Koppenwallner, H. Legge, and H. Mueller Sep. 1971 22 p refs Presented at the 22nd Intern. Astronaut. Congr., Brussels, 20-26 Sep. 1971

Avail: NTIS CSCL 22A

The aerodynamic characteristics of the Apollo command module were investigated in hypersonic low density tnnnels. These wind tunnel investigations included: drag measurements at zero lift, three component force measurements, and heat transfer measurements. Author

N72-12977# Weapons Research Establishment, Salisbury (Australia).

THE MAGNUS CHARACTERISTICS OF A SPINNING INCLINED OGIVE-CYLINDER BODY AT SUBCRITICAL REYNOLDS NUMBERS IN INCOMPRESSIBLE FLOW

C. A. J. Fletcher Jun. 1971 80 p refs

(WRE-423) Avail: NTIS

The side force and normal force characteristics of a spinning cylindrical body with a tangent ogive nose were determined for angles of incidence from 0 to 30 deg, spin ratios (peripheral velocity/cross flow velocity) 0 to 1, body lengths 4.42 to 8.25 kalibers and Reynolds numbers (based on diameter) of 200,000 and 250,000. The side force varies nonlinearly with spin ratio and incidence, but is always positive. Vortex locations were obtained in the wake behind the 7.07 caliber body at angles of incidence 15 to 30 deg, and spin ratios 0 to 1 in the Reynolds number range 6400 to 250,000. Evidence of tertiary vortices was not obtained except at a Reynolds number of 50,000. At a spin ratio of 0.5 the vortices assumed markedly different asymmetric patterns at Reynolds numbers of 50,000 and 200,000. Cross flow separation angles were measured along the 7.07 caliber body at angles of incidence 15 and 30 deg, spin ratios 0 to 1 and Reynolds numbers 50,000 and 200,000. The cross flow separation position is found to be weakly dependent on axial position. The cross flow separation angle moves with the spin except on the high pressure side of the model at a spin ratio bf 0.5 and a Reynolds number of 200,000. Author

N72-12978# Advisory Group for Aerospace Research and Development, Paris (France).
AERODYNAMIC TESTING AT HIGH REYNOLDS NUMBERS AND TRANSONIC SPEEDS
D. Kuechemann (Roy. Aircraft Estab., Farnborough, Engl.) Nov. 1971 9 p refs Presented at NATO Defence Res. Group Seminar on Gen. Probl. Relating to Aerodyn. Testing Facilities, St. Louis, France, 4-7 May 1971
(AGARD-R-588-71) Avail: NTIS

As a contribution to a NATO seminar on aerodynamic testing facilities held at the ISL from 4 to 7 May 1971, a brief report is given on the outcome of a specialists' meeting organized by the fluid dynamics panel of AGARD and held at Gottingen from 26 to 28 April 1971. Various AGARD activities, leading up to this meeting, are also briefly described. The best technical advice available within AGARD leads to the conclusion that one or several large new wind tunnels would contribute immensely to the effectiveness of a large number of aerospace systems now planned or contemplated within the NATO nations. Author

N72-12979*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
TOLERANCE OF MACH 2.50 AXISYMMETRIC MIXED-COMPRESSION INLETS TO UPSTREAM FLOW VARIATIONS
David A. Choby Washington Jan. 1972 52 p refs
(NASA-TM-X-2433; E-6452) Avail: NTIS CSCL 20D

An investigation of the tolerances of two Mach 2.50 axisymmetric mixed-compression inlets to upstream flow variations was conducted. Tolerances of each inlet to angle of attack as a function of decreasing free-stream Mach number were obtained. A local region of overcompression was formed on the leeward side of the inlet at maximum angle of attack before unstart. This region of overcompression corresponded to local subsonic flow conditions ahead of the geometric throat. A uniform Mach number gradient of 0.10 at the cowl lip plane did not affect the inlet's pressure recovery, mass flow ratio, or diffuser exit total-pressure distortion. Author

N72-12980*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
EFFECTS OF REYNOLDS NUMBER AND BODY CORNER RADIUS ON AERODYNAMIC CHARACTERISTICS OF A SPACE SHUTTLE-TYPE VEHICLE AT SUBSONIC MACH NUMBERS
Leland H. Jorgensen and Jack J. Brownson Washington Jan. 1972 32 p refs
(NASA-TN-D-6615; A-4153; UNIT-750-117-07-02-21) Avail: NTIS CSCL 22A

Static aerodynamic forces and moments were measured to study the effects of Reynolds number and body corner radius on the aerodynamic characteristics of a straight wing space shuttle orbiter at subsonic speeds. A 0.02-scale model was tested at Mach numbers from 0.3 to 0.9 and Reynolds numbers from about 600,000 to 3 million, based on body width. The body alone and the body with its wing and horizontal tail attached were tested at angles of attack from 35 to 75 degrees. The effects of rounding the body corners at the junctures connecting the bottom and sides were investigated for corner radii from 0 to 8.5 percent of the body width. At low subsonic Mach numbers (free stream Mach number approximately equal 0.3) the aerodynamic characteristics are affected significantly by changes in Reynolds number and body corner radius. With increase in Mach number to free stream Mach number = 0.9 the effect of Reynolds number seems to vanish, but a significant effect of body corner radius remains. Author

N72-12981# National Aerospace Lab., Tokyo (Japan).
FREE FLIGHT TESTS ON LONGITUDINAL DYNAMIC CHARACTERISTICS OF FFM-10 MODEL
Toshio Kawasaki, Taketoshi Hanawa, Hideo Saito, Kazuaki Takashima, and Iwao Kawamoto Jul. 1971 20 p refs In JAPANESE; ENGLISH summary
(NAL-TR-237) Avail: NTIS

The free flight model simulates a supersonic aircraft with delta wing. It is propelled by a rocket motor installed in the fuselage. Longitudinal short period motion is produced by two side jets ignited in sequence. Measurements of acceleration in the direction of pitching motion permit the determination of longitudinal static and dynamic aerodynamic derivatives. The results are compared with theoretical estimates and show fairly good agreement. Author

N72-12982*# Scientific Translation Service, Santa Barbara, Calif.
CALCULATION PROCEDURES FOR THREE DIMENSIONAL AERODYNAMICS IN PERFECT FLUIDS
P. Perrier and W. Vitte Washington NASA Dec. 1971 33 p refs Transl. into ENGLISH from Proceedings of 7th Aerodyn. Colloq., Assoc. Franc. des Ingr. et Technicians de l'Aeron. et de l'Espace, (Modane and Ecully), 4-6 Nov. 1970 39 p
(Contract NASw-2035)
(NASA-TT-F-14074) Avail: NTIS CSCL 01A

The three-dimensional problem of vortex interaction and its effect on lift, drag and other aerodynamic properties of various wing and aircraft configurations is treated by a new analytical method. The aerodynamic surfaces are replaced by equivalent surface elements. The data are displayed on an IBM terminal. Author

N72-12983*# Scientific Translation Service, Santa Barbara, Calif.
THE HIGH LIFT WING: REMARKS ON THE PREDICTION OF CHARACTERISTICS
Y. Semezis and J. Gombert Washington NASA Dec. 1971 69 p refs Transl. into ENGLISH of "L' Aile aux Portances Elevees. Remarques sur la Prevision des Caracteristiques" Chatillon, Soc. Natl. Ind., Aerospatiale, 1971 85 p Presented at 7th Appl. Aerodyn. Colloq., Modane and Ecully, France, 4-6 Nov. 1971
(Contract NASw-2035)
(NASA-TT-F-14073) Avail: NTIS CSCL 01A

Problems encountered in predicting the characteristics of high lift wings, with or without additional high lift devices, are examined. Existing means of controlling lift or distributing the load on a wing by detachment are considered. Particular emphasis is placed on the processes of prediction of maximum lift coefficient and its increase by means of high lift devices. These are compared for the case of a moderately long and moderately swept-back wing equipped with conventional high lift devices. It is considered that improvement in prediction is related to a better understanding of detechment phenomena. Results of current studies are briefly reviewed, and various procedures to increase lift by blowing are described. Author

N72-12984# Joint Publications Research Service, Washington, D.C.
ON UTILIZING THE KINETIC ENERGY OF THE JET OF A TURBOJET ENGINE TO PROVIDE AN ADDITIONAL LIFTING FORCE ON THE WINGS OF THE AIRCRAFT
V. A. Kosterin and V. M. Yermolayev 23 Dec. 1971 12 p refs Transl. into ENGLISH from Tr. Kaz. Aviats. Inst. (USSR), no. 88, 1965 p 92-103
(JPRS-54785) Avail: NTIS

The thrust efficiency of turbojet engines in modern jet aircraft is considerably less than unity as shown in the design dependence of a turbojet engine on Mach number. It is evident from the curve that at subsonic flight speeds only 40-50% of the kinetic energy of gases passing through the engine are spent usefully, i.e. for performing the work of flight. The remaining 50-60% are lost. Transmission of the kinetic gas energy after the engine to the larger amounts of air passing around the airfoils of an aircraft raises the propulsive qualities of a turbojet engine. A simplified procedure has been developed for determining the aerodynamic characteristics of thin profiles when a gas jet is directed at a tangent to a profile's upper surface. Author

N72-12985# Grumman Aerospace Corp., Bethpage, N.Y.
THREE DIMENSIONAL SUPERSONIC FLOW OVER A SMOOTH BODY WITH SHOCK-PRODUCING PROTUBERANCE
Richard A. Scheuing May 1971 183 p refs
(AD-728501; RE-406) Avail: NTIS CSCL 01/1

The investigation is directed primarily at the second order solution of the three dimensional, supersonic flow field around an arbitrarily-shaped body which, although otherwise of smooth contour, has a protuberance that generates a shock wave and substantially disturbs the flow downstream. Such configurations occur for example, in fuselage-canopy combinations. The calculation of the flow field about a body with no local protuberance is considered first, the solution being based on the so-called method of near-characteristics. Typical numerical results are presented for circular and elliptic cones, tangent ogives of circular and elliptic cross section, and a representative non-axisymmetric compression surface. Comparisons with results from conical flow theories and with experimental data are made wherever possible. The theoretical analysis and computational procedure evolved for the primary body is then extended to permit the addition of the shock-producing protuberance. This approach enable the flow upstream of the secondary shock to be considered uniform. GRA

N72-12986# Naval Ship Research and Development Center, Washington, D.C. Aviation and Surface Effects Dept.
METHOD FOR PREDICTING THE STATIC AERODYNAMIC CHARACTERISTICS OF TYPICAL MISSILE CONFIGURATIONS FOR ANGLES OF ATTACK TO 180 DEGREES Research and Development Report
Bernard F. Saffell, Jr., Millard L. Howard, and Eugene N. Brooks, Jr. Mar. 1971 44 p refs
(WW Proj. 16-25)
(AD-729009; AERO-1168; NSRDC-3645) Avail: NTIS CSCL 16/4

A method for predicting the static, longitudinal aerodynamic characteristics of typical missile configurations at zero roll angle (i.e., in a plus configuration) has been developed and programmed for use on the IBM 7090 digital computer. It can be applied throughout the subsonic, transonic, and supersonic speed regimes to slender bodies of revolution or to nose-cylinder body combinations with low aspect-ratio lifting surfaces. The aerodynamic characteristics can be computed for missile configurations operating at angles of attack up to 180 degrees. The effect of control surface deflections for all modes of aerodynamic control are taken into account by this method. The method is based on well-known linear, nonlinear crossflbw and slender body theories with empirical modifications to provide the high angle of attack capability. Comparisons of the theory with experimental data are presented to demonstrate the accuracy of the method. Author (GRA)

N72-12997*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
HIGH-LIFT AERODYNAMICS
Alexander D. Hammond *In its* Vehicle Technol. for Civil Aviation 1971 p 15-26 refs (See N72-12995 04-02)
Avail: NTIS HC $6.00/MF $0.95 CSCL 01A

N72-12998*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SUBSONIC AND TRANSONIC AERODYNAMIC RESEARCH
Edward C. Polhamus *In its* Vehicle Technol. for Civil Aviation 1971 p 27-44 refs (See N72-12995 04-02)
Avail: NTIS HC $6.00/MF $0.95 CSCL 01A

N72-12999*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SUPERSONIC AERODYNAMIC TECHNOLOGY
Harry W. Carlson *In its* Vehicle Technol. for Civil Aviation 1971 p 45-61 refs (See N72-12995 04-02)
Avail: NTIS HC $6.00/MF $0.95 CSCL 01A

N72-13000*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
HYPERSONIC AIRPLANE AERODYNAMIC TECHNOLOGY
Dennis M. Bushnell *In its* Vehicle Technol. for Civil Aviation 1971 p 63-84 refs (See N72-12995 04-02)
Avail: NTIS HC $6.00/MF $ 0.95 CSCL 01A

N72-13018*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
PROPERTIES OF OBLIQUE-WING/BODY COMBINATIONS FOR LOW SUPERSONIC SPEEDS
Robert T. Jones *In its* Vehicle Technol. for Civil Aviation 1971 p 389-407 refs (See N72-12995 04-02)
Avail: NTIS HC $6.00/MF $0.95 CSCL 01A

02 AIRCRAFT

Includes fixed-wing airplanes, helicopters, gliders, balloons, ornithopters, etc; and specific types of complete aircraft (e.g., ground effect machines, STOL, and VTOL); flight tests; operating problems (e.g., sonic boom); safety and safety devices; economics; and stability and control. For basic research see: 01 Aerodynamics. For related information see also: 31 Space Vehicles; and 32 Structural Mechanics.

N72-12987# National Aviation Facilities Experimental Center, Atlantic City, N.J.
FIRE EXTINGUISHING METHODS FOR NEW PASSENGER/CARGO AIRCRAFT Final Report, Jul. 1969 - Feb. 1971
Julius J. Gassmann and Richard G. Hill Nov. 1971 39 p refs (Proj. 502-201-02X)
(FAA-NA-71-23; FAA-RD-71-68) Avail: NTIS

Full-scale fire tests were conducted to determine the degree to which fire in large cargo compartments may be controlled by the use of bromotrifluoromethane as an extinguishing method in conjunction with ventilation shutoff. Results of the tests, using a 10-percent load, indicated that temperature can be kept below 500F and that a flash fire can be averted for at least 2 hours by the use of as little as 3 percent by volume of bromotrifluoromethane. The rate of agent application was about 3 1/2 pounds per second. During these tests, the normal leakage that occurs while in flight configuration was simulated by providing an airflow of 75 cubic feet per minute. Two tests were conducted to determine the effectiveness of liquid nitrogen as an extinguishing agent. The weights of agent used were 175 pounds and 284 pounds, respectively. The use of liquid nitrogen proved very effective in extinguishing the initial flames, but with the 75 CFM

simulated leakage, when the oxygen concentration rose to 12 percent, a flash fire occurred. In both cases the protection lasted just over 30 minutes. The rate of application of application of the liquid nitrogen was as high as 10 pounds per second. Author

N72-12988*# Wyle Labs., Inc., Hampton, Va.
AN EVALUATION OF METHODS FOR SCALING AIRCRAFT NOISE PERKEPTION
J. B. Ollerhead Washington NASA Oct. 1971 147 p refs
(Contract NAS1-9257)
(NASA-CR-1883) Avail: NTIS CSCL 20A

One hundred and twenty recorded sounds, including jets, turboprops, piston engined aircraft and helicopters were rated by a panel of subjects in a paired comparison test. The results were analyzed to evaluate a number of noise rating procedures in terms of their ability to accurately estimate both relative and absolute perkeived noise levels. It was found that the complex procedures developed by Stevens, Zwicker and Kryter are superior to other scales. The main advantage of these methods over the more convenient weighted sound pressure level scales lies in their ability to cope with signals over a wide range of bandwidth. However, Stevens' loudness level scale and the perceived noise level scale both overestimate the growth of perceived level with intensity because of an apparent deficiency in the band level summation rule. A simple correction is proposed which will enable these scales to properly account for the experimental observations. Author

N72-12989# Royal Aircraft Establishment, Farnborough (England).
OPERATING LOADS ON THE MAIN UNDERCARRIAGES OF THE F-104 G AIRCRAFT
O. Buxbaum Jun. 1971 73 p refs Transl. into ENGLISH from Betriebskraefte an Hauptfahrwerken des Flugzeuges F-104 G, Lab. fuer Betriebsfestigkeit, Darmstadt, report FB-82, 1969
(RAE-Lib-Trans-1591; FB-82; UDC-533.6.048.3; UDC-629.13.015.11; UDC-629.13.074; BR26988) Avail: NTIS

At the main landing gears of two airplanes, vertical, lateral and drag loads have been recorded continuously during 50 flights and have been analyzed statistically. The report presents, for the loading conditions: landing, spring-back, taxi, transition, braking, engine run-up, turning and pivoting, cumulative frequency and extreme value distributions of the loads in the three axes, as well as information about the correlation between simultaneously occurring load components. Author

N72-12990*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SUMMARY OF SPIN TECHNOLOGY AS RELATED TO LIGHT GENERAL-AVIATION AIRPLANES
James S. Bowman, Jr. Washington Dec. 1971 34 p refs
(NASA-TN-D-6575; L-7952) Avail: NTIS CSCL 01A

A summary was made of all NASA (and NACA) research and experience related to the spin and recovery characteristics of light personal-owner-type general-aviation airplanes. Very little of the research deals with light general-aviation airplanes as such, but many of the airplanes and models tested before and during World War II were similar to present-day light general-aviation airplanes with regard to the factors that are important in spinning. The material is based mainly on the results of spin-tunnel tests of free-spinning dynamically scaled models of about 100 different airplane designs and, whenever possible, includes correlation with full-scale spin tests. The research results are discussed in terms of airplane design considerations and the proper use of controls for recovery. Author

N72-12991*# Michigan Univ., Ann Arbor. Tire and Suspension Systems Research Group.
AN EVALUATION OF STRING THEORY FOR THE PREDICTION OF DYNAMIC TIRE PROPERTIES USING SCALE MODEL AIRCRAFT TIRES
S. K. Clark, R. N. Dodge, and G. H. Nybakken Aug. 1971 52 p refs
(Grant NGL-23-005-010)
(NASA-CR-112007; Rept-056080-18-T; TR-12) Avail: NTIS CSCL 01A

A number of scale models were made, and their static elastic constants, as well as slow speed rolling constants, were determined. These data were used as input for a sequence of tire calculations which employed both point contact and finite contact patch length theory. Computations were carried out for the cases of a wheel under forced sinusoidal steer angle oscillation and a wheel under forced sinusoidal lateral displacement of the wheel hub center. The computations were compared with data obtained from the small-scale tires under dynamic tests on a 30-in. diameter small-scale road wheel. It was found that the critical ratio describing these motions was path dependent. The data also showed good linearity of force and moment characteristics with input steer or displacement amplitudes. In general the experimental data agreed well with calculations based on finite contact patch string theory. Author

N72-12992* Massachusetts Inst. of Tech., Cambridge. Aeroelastic and Structures Research Lab.
INVESTIGATION OF ROTOR BLADE TIP-VORTEX AERODYNAMICS Final Report, 1 Jun. 1968 - 30 Sep. 1971
W. S. Lewellen 30 Sep. 1971 4 p refs
(Grant NGR-22-009-303)
(NASA-CR-112009) Avail: NTIS CSCL 01A

Several aspects of the aerodynamics of rotor blade tip vortices are examined. Two particular categories are dealt with; (1) dynamic loads on a blade passing close to or intersecting a trailing vortex, and (2) the response of the trailing vortex core to changes in the flow. Results for both categories are in reasonable agreement with existing data, although lower pressure gradients were obtained than anticipated for category one. A correlation between trailing edge sweep angle at the tip and vortex core size was noted for category two. E.H.W.

N72-12993# General Applied Science Labs., Inc., Westbury, N.Y.
SONIC BOOM MINIMIZATION THROUGH AIR STREAM ALTERATION Final Report
F. W. Lipfert Jul. 1971 138 p refs
(Contract DOT-FA70WA-2320)
(TR-760; FAA-RD-71-90) Avail: NTIS

The potential of modifying supersonic aircraft sonic boom signatures by means of altering the flow field in the vicinity of the aircraft was investigated theoretically. A specific airplane, the NASA SCAT-15F, was selected as a basis, and a cruise flight condition of Mach 2.7, 62,000 feet was chosen. Signatures were computed using real (1962) atmospheric properties. Finite rise times, reduced overpressures, and reduced shock pressure rises were among the signature improvements investigated. Flow field alteration mechanisms considered included free combustion, boundary layer mass addition, force fields, and laser-generated heat fields. Weight penalties of the order of the baseline aircraft gross weight were found for all attempts to modify the complete baseline aircraft signature. If this additional weight were borne by the baseline aircraft, an additional overpressure would result which would, in many cases, negate the effect of the signature improvement. Considerably smaller weight penalties (by factors of 4-5) were found to be required to create a precursor signal that would warn of the impending sonic boom. Author

N72-12994*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
BOUNDARY LAYER TRANSITION DETECTION ON THE X-15 VERTICAL FIN USING SURFACE-PRESSURE-FLUCTUATION MEASUREMENTS
Thomas L. Lewis and Richard D. Banner Washington Dec. 1971 17 p refs
(NASA-TM-X-2466; H-660) Avail: NTIS CSCL 01A

A flush-mounted microphone on the vertical fin of an X-15

airplane was used to investigate boundary layer transition phenomenon during flights to peak altitudes of approximately 70,000 meters. The flight results were compared with those from wind tunnel studies, skin temperature measurements, and empirical prediction data. The Reynolds numbers determined for the end of transition were consistent with those obtained from wind tunnel studies. Maximum surface-pressure-fluctuation coefficients in the transition region were about an order of magnitude greater than those for fully developed turbulent flow. This was also consistent with wind tunnel data. It was also noted that the power-spectral-density estimates of the surface-pressure fluctuations were characterized by a shift in power from high frequencies to low frequencies as the boundary layer changed from turbulent to laminar flow. Large changes in power at the lowest frequencies appeared to mark the beginning of transition. Author

N72-12995*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
VEHICLE TECHNOLOGY FOR CIVIL AVIATION: THE SEVENTIES AND BEYOND Conference Proceedings
Washington 1971 452 p refs Conf. held at Langley Sta., Va., 2-4 Nov. 1971
(NASA-SP-292) Avail: NTIS HC $6.00/MF $0.95 CSCL 01C

Technological concepts for the development of future advanced transport aircraft in civil aviation are developed. Highlighted are promising avenues of research that offer the potential of improving both current and future civil aircraft in the fields of aerodynamics, propulsion, structures and materials, operational aspects, and technology application. For individual titles, see N72-12996 through N72-13020.

N72-12996*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
VEHICLE TECHNOLOGY FOR CIVIL AVIATION: THE SEVENTIES AND BEYOND. KEYNOTE ADDRESS
E. M. Cortright *In its* Vehicle Technol. for Civil Aviation 1971 p 1-14 (See N72-12995 04-02)
Avail: NTIS HC $6.00/MF $0.95 CSCL 01C

Future trends and opportunities in civil aviation are considered in technological forecasting of transport vehicle developments for the next decade. Vehicle technology is assessed in the framework of total air transportation systems and projected economic growth. Improved aircraft type developments involve the design of STOL transports with augmented lift concepts, control systems, and cross-wind landing gear; advanced helicopter and tilt-rotor vehicles for short-haul and long-haul commerce; and the possibility of hypersonic transports. While most of the technology for second generation SST up to Mach 3 is within reach, still faster transportation will require dramatic technical advances. Author

N72-12997*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
HIGH-LIFT AERODYNAMICS **c01**
Alexander D. Hammond *In its* Vehicle Technol. for Civil Aviation 1971 p 15-26 refs (See N72-12995 04-02)
Avail: NTIS HC $6.00/MF $0.95 CSCL 01A

There is a continuing interest in the development of high-lift devices for improving the take-off and landing performance of civil transport aircraft. Some of the important aspects of the development of high-lift systems were presented. The high-lift devices to be discussed include both powered- and unpowered-lift concepts. The landing performance that can be attained with the use of present-day state-of-the-art lifting systems as well as the predicted improvements in performance are related to some of the limitatiofs imposed by operational constraints, particularly tye limitations imposed on the usable lift of powered-lift concepts. Author

N72-12998*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SUBSONIC AND TRANSONIC AERODYNAMIC RESEARCH **c01**
Edward C. Polhamus *In its* Vehicle Technol. for Civil Aviation 1971 p 27-44 refs (See N72-12995 04-02)
Avail: NTIS HC $6.00/MF $0.95 CSCL 01A

Results of some subsonic and transonic aerodynamic research applicable to the design of civil aircraft in the 1970's and beyond are presented, and some of the needs for future research are outlined. Advances in technology afforded by the supercritical aerodynamic concepts and the combination of control-configured vehicle and variable-wing-sweep concepts are discussed, and both progress and needs in aerodynamic theory in the area of component interference, mixed flow, and leading-edge vortex flow are reviewed. Author

N72-12999*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SUPERSONIC AERODYNAMIC TECHNOLOGY **c01**
Harry W. Carlson *In its* Vehicle Technol. for Civil Aviation 1971 p 45-61 refs (See N72-12995 04-02)
Avail: NTIS HC $6.00/MF $0.95 CSCL 01A

Supersonic aerodynamic design technology, which has advanced dramatically within the past decade, is expected to undergo continual refinement. Maximum liftdrag ratios in excess of 10 can be anticipated for large SST aerodynamic designs which have a reasonable promise for development into practical aircraft. Much progress has been made in exploration of the sonic-boom-minimization problem; however, there is not yet any development that promises sonic-boom reduction to such an extent as to permit unrestricted overland SST operations. Author

N72-13000*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
HYPERSONIC AIRPLANE AERODYNAMIC TECHNOLOGY **c01**
Dennis M. Bushnell *In its* Vehicle Technol. for Civil Aviation 1971 p 63-84 refs (See N72-12995 04-02)
Avail: NTIS HC $6.00/MF $ 0.95 CSCL 01A

The status of hypersonic aircraft aerodynamic technology is reviewed and critical research areas for the 1970's are determined. The outlook for numerical flow-field calculations and recent research in the problem areas of engine-airframe integration, slot injection as an active airframe cooling technique, lee-side vortex heating, and hypersonic boundary-layer transition are considered. It is concluded that with realistic progress in aerodynamic technology, an efficient hypersonic cruise aircraft can be developed. The most critical area for research is the integration of the air-breathing propulsion system with the lower surface of the aircraft, since the forebody compression surface acts as an inlet spike and the lower part of the vehicle afterbody acts as an exhaust nozzle for the propulsion modules. Also a significant gain in payload can accrue from the further development and application of active cooling technology for both external and internal cooling concepts. Author

N72-13001*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
MATERIALS FOR JET ENGINES **c28**
John C. Freche *In its* Vehicle Technol. for Civil Aviation 1971 p 85-106 refs (See N72-12995 04-02)
Avail: NTIS HC $6.00/MF $0.95 CSCL 21E

The key to improved turbojet engine performance lies in the development of suitable materials and the engineering techniques required to use these materials effectively. Discussed herein are the improvements that can be expected during the ensuing decade in the materials used for key engine components, such as the fan blades and early-stage compressor blades, the latter-stage compressor blades, the turbine disks, and the turbine stator vanes and blades. Some of the materials problems posed by the engine environment, particularly corrosion and thermal fatigue, are also discussed as are some of the more advanced protection systems designed to solve these problems. Author

N72-13002*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SUBSONIC AND SUPERSONIC PROPULSION c28
Milton A. Beheim, Robert L. Cummings, James F. Dugan, Jr., Charles E. Feiler, Jack S. Grobman, and Warner L. Stewart *In its* Vehicle Technol. for Civil Aviation 1971 p 107-156 (See N72-12995 04-02)
Avail: NTIS HC $6.00/MF $0.95 CSCL 21E

About a year ago a 3-day conference on propulsion was held at the NASA Lewis Research Center. The present paper is a broad overview of that material and an attempt is made to forecast trends. An outline lists various kinds of airplanes and the types of engines that seem right for them. A conventional-takeoff-and-landing transport of the future could be a near-sonic airplane. A short-takeoff-and-landing airplane might either use a very high bypass turbofan, if it had externally blown flaps, or a medium bypass turbofan, if it had an augmentor wing. Vertical and short takeoff-and-landing aircraft that are powered by integral lift fans or else by remote lift fans are also considered. In the latter case a separate engine supplies working fluid to the lift-fan unit. A future supersonic transport might use low-bypass turbofan engines. For general aviation, a geared turbofan could provide the right balance between performance and cost. Author

N72-13003*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
HYPERSONIC AIR-BREATHING PROPULSION SYSTEMS c28
John R. Henry and H. Lee Beach *In its* Vehicle Technol. for Civil Aviation 1971 p 157-177 refs (See N72-12995 04-02)
Avail: NTIS HC $6.00/MF $0.95 CSCL 21A

An overview of the various possibilities for air-breathing propulsion systems for cruise applications is presented and an assessment of their present status and their future potential is gien. Clearly, there is a need for exploratory research and imaginative solutions in many areas in order to realize the apparent potential of air-breathing engine types. In this regard, several promising approaches to the design of the airframe-integrated scramjet (supersonic combustion ramjet) are described in some detail. Emphasis is placed on scramjet development because it has inherent qualities, such as high performance over wide ranges of flight speeds and geometric and mechanical simplicity, which make it a leading candidate for many hypersonic applications. Author

N72-13004*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
STRUCTURES TECHNOLOGY FOR HYPERSONIC VEHICLES
Melvin S. Anderson and H. Neale Kelly *In its* Vehicle Technol. for Civil Aviation 1971 p 179-192 refs (See N72-12995 04-02)
Avail: NTIS HC $6.00/MF $0.95 CSCL 01C

The technology base that has been established for the primary structural components of hypersonic aircraft is reviewed, and areas where additional research is required, if hypersonic cruise flight is to become a practical reality, are indicated. Author

N72-13005*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
MATERIALS APPLICATION TO CIVIL AIRCRAFT STRUCTURES IN THE SEVENTIES AND BEYOND
Richard A. Pride *In its* Vehicle Technol. for Civil Aviation 1971 p 193-207 refs (See N72-12995 04-02)
Avail: NTIS HC $6.00/MF $0.95 CSCL 01C

The current status and projections for materials usage for the 1970's and beyond in civil aircraft structures are considered. Metal structural alloys and composite materials, with most of the emphasis on composites, are discussed. Such drivers for future development as fracture toughness and corrosion resistance for metals and response to environment, maintainability, and costs for composites are projected. Programs which demonstrate the benefits to be realized, such as weight reduction, improved performance, and increased longevity, are presented. Author

N72-13006*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
FATIGUE AND FRACTURE c32
Herbert F. Hardrath *In its* Vehicle Technol. for Civil Aviation 1971 p 209-224 refs (See N72-12995 04-02)
Avail: NTIS HC $6.00/MF $0.95 CSCL 20K

The four major parameters that govern fatigue behavior are choice of materials (metals and composites), configuration, load experience, and environments (thermal and chemical). Emphasis is placed on choice of materials, configuration, and load experience in designing against fatigue and fracture for future aircraft. Also included is a description of a research program that should lead to improvements in the state of the art of fatigue analysis so that aircraft may be designed to have maximum efficiency consistent with high reliability. Author

N72-13007*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AUTOMATED DESIGN METHODS IN STRUCTURAL TECHNOLOGY c32
Harvey G. McComb, Jr. *In its* Vehicle Technol. for Civil Aviation 1971 p 225-243 refs (See N72-12995 04-02)
Avail: NTIS HC $6.00/MF $0.95 CSCL 20K

The impact of automation is considered for three areas: structural anlaysis, structural design, and integrated design. The term structural analysis simply refers to the determination of stresses or internal loads and deflections in a given structure under given loading conditions. Structural design, on the other hand, involves incorporation of the analysis into a resizing and reanalysis procedure in which structural allowables are taken into account and the process is cycled to a converged design. Finally, the term integrated design is used to refer to interdisciplinary approaches where modules from several disciplines are integrated into unified systems for analysis and design of aeronautical vehicles. Author

N72-13008*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
ADVANCED ACTIVE CONTROLS TECHNOLOGY
A. Gerald Rainey *In its* Vehicle Technol. for Civil Aviation 1971 p 245-257 refs (See N72-12995 04-02)
Avail: NTIS HC $6.00/MF $0.95 CSCL 01C

Advanced active control concepts are described and their potential for providing improved characteristics for aircraft, along with an indication of the status of the technology in relation to its readiness for application, is given. The concepts considered are relaxed aerodynamic stability, maneuver load control, flutter suppression, fatigue damage reduction, and ride quality control. Author

N72-13009*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
THE AIRPORT-AIRPLANE INTERFACE: THE SEVENTIES AND BEYOND
John P. Reeder *In its* Vehicle Technol. for Civil Aviation 1971 p 259-269 refs (See N72-12995 04-02)
Avail: NTIS HC $6.00/MF $0.95 CSCL 01C

A projection of current technologies relating the airplane and the airport for an advanced transportation system is reported. It deals primarily with transport aircraft in high-density traffic. The order of discussion is as follows: (1) Air transportation situation; (2) Technical status of the operating system; and (3) Airport-airplane interface. Author

N72-13010*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
THE PILOT-AIRCRAFT INTERFACE c05
George E. Cooper *In its* Vehicle Technol. for Civil Aviation

1971 p 271-286 refs (See N72-12995 04-02)
Avail: NTIS HC $6.00/MF $0.95 CSCL 05E

The pilot-aircraft interface centers in the cockpit but is specifically represented by the means through which the pilot receives his information and through which he, in turn, controls or communicates with the aircraft and the environment. In any aircraft each of the pilot's channels of sensory perception is utilized in one way or another. The predominate input channel is visual. First an attempt to define the nature of the problem is made; then the state of technology in this area is briefly considered. Next, the requirements for applying this technology as well as that for assessing promising technology for application to the pilot-aircraft interface are examined. Then a review is made of the most important elements of technology which should be used during the 1970's and which will have a significant impact on the civil transport cockpit of the 1980's.
Author

N72-13011*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
ADVANCED AVIONIC SYSTEMS
G. Barry Graves, Jr. *In its* Vehicle Technol. for Civil Aviation 1971 p 287-300 (See N72-12995 04-02)
Avaiw: NTIS HC $6.00/MF $0.95 CSCL 01B

The development of avionics is illustrated by stability augmentation systems (SAS) and automatic landing equipment incorporated in the latest series of transports to obtain the desired handling qualities and to improve operations during approach and landing. Area navigation equipment is available to provide flexiblity in using the existing network of ground-based navigation stations. Also, a new microwave landing system which will greatly improve the accuracy of landing guidance signals and permit maneuvering during approach is projected. Expected future developments include the following three items: computer-centered digital systems for both flight management and advanced control applications; automated communications; and systems for wide-area navigation and surveillance. Author

N72-13012*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
TRENDS IN AIRCRAFT NOISE ALLEVIATION
Yomer G. Morgan *In its* Vehicle Technol. for Civil Aviation 1971 p 301-315 refs (See N72-12995 04-02)
Avail: NTIS HC $6.00/MF $0.95 CSCL 20A

The principal sources of aircraft noise are engines, rotors and propellers, boundary layers, and the sonic boom. Elimination or reduction of noise at the source is the most obvious approach to moise abatement. New operational procedures, such as the steep approach, reduce engine noise by operating at reduced power while also lengthening transmission paths of the noise through the atmosphere so that less noise reaches airport communities. Flight or ground structures can also be used to shield passengers or the public from direct impingement by the noise that cannot be eliminated at the source. In any event, a problem exists when noise reaching a receiver causes annoyance (people) or degraded performance (people or structures). The effects of noise on people and structures and noise reduction from rotary-wing vehicles are discussed. Author

N72-13013*# National Aeronautics and Space Administration. Flight Research Center, Edwards, Calif.
GENERAL AVIATION: THE SEVENTIES AND BEYOND
M. R. Barber and Jack Fischel *In its* Vehicle Technol. for Civil Aviation 1971 p 317-332 refs (See N72-12995 04-02)
Avaiw: NTIS HC $6.00/MF $0.95 CSCL 01C

The possible advancements in general aviation through the applications of technology during the next decade are discussed in terms of aircraft performance, utility, safety, and public acceptance. Author

N72-13014*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
DIRECT-LIFT JET V/STOL CONCEPTS
Curt A. Holzhauser *In its* Vehicle Technol. for Civil Aviation 1971 p 333-343 refs (See N72-12995 04-02)
Avail: NTIS HC $6.00/MF $0.95 CSCL 01C

Direct-lift jet-powered V/STOL concepts have the greatest potential for future short-haul transportation. Such aircraft can be produced with current technology; however, they would be deficient in weight, noise, and operational characteristics. It is shown how advanced technology can improve direct-lift jet V/STOL transports. Anticipated improvements in structures, propulsion, and aerodynamics and their effects on advanced V/STOL transport designs are noted. In addition, low-speed control and operation is also considered because of the unique performance capability of V/STOL aircraft. Recent flight experience with direct-lift jet V/STOL aircraft is used as a basis of the control and operational considerations. Author

N72-13015*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
ROTORCRAFT APPLICATIONS AND TECHNOLOGY
Robert J. Tapscott *In its* Vehicle Technol. for Civil Aviation 1971 p 345-358 (See N72-12995 04-02)
Avail: NTIS HC $6.00/MF $0.95 CSCL 01C

The helicopter, because of its inherent advantage of lifting capability at hover or low speeds for long periods of time, is finding increased usage even without special attention to the development of economical and operationally suitable vehicles for this kind of applications. The principle targets for the application of technology to improve the helicopter are propulsion systems, noise abatement, vibration and structural integrity, and instrument flight capability. Aeroelastic analysis, structural concepts, and rotor geometry are discussed and some of the technologies relating to instrument flight for helicopters are indicated. Author

N72-13016*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
EFFECTS OF ADVANCED TECHNOLOGY ON STOL TRANSPORT AIRCRAFT
Woodrow L. Cook *In its* Vehicle Technol. for Civil Aviation 1971 p 359-373 refs (See N72-12995 04-02)
Avail: NTIS HC $6.00/MF $0.95 CSCL 01C

The objectives of this study are as follows: (1) application of specific technology advances to commercial STOL transportation; (2) total effect of technology advances on STOL transport aircraft gross weight, direct operating cost, and acceptance; and (3) assessment of advanced technology progress for STOL transportation in the 1980's. Author

N72-13017*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
SUBSONIC-TRANSONIC TRANSPORT AIRCRAFT PROJECTIONS
William J. Alford, Jr. *In its* Vehicle Technol. for Civil Aviation 1971 p 375-388 refs (See N72-12995 04-02)
Avail: NTIS HC $6.00/MF $0.95 CSCL 01C

The application of advanced technologies to subsonic-transonic conventional take-off and landing (CTOL) transport aircraft and their characteristics in the 1980's are discussed. The goals to be demanded of aircraft of this time period are reductions of the effects of noise and pollutant emissions on the environment, and the maintenance of competitive superiority in the world's aircraft market. The discussion deals primarily with long-haul aircraft; however, brief consideration are given to the outlook for the short/medium-haul class. The material presented is based on results from NASA in-house programs and from contracted advanced transport technology studies. Author

N72-13018*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
PROPERTIES OF OBLIQUE-WING/BODY COMBINATIONS FOR LOW SUPERSONIC SPEEDS c01
Robert T. Jones *In its* Vehicle Technol. for Civil Aviation 1971

p 389-407 refs (See N72-12995 04-02)
Avail: NTIS HC $6.00/MF $0.95 CSCL 01A

In theory, antisymmetric arrangements of wings and bodies can have smaller wave drag than corresponding mirror-symmetric arrangements. Thus, a long narrow oblique wing which presents tye same aspect for two opposite directions of flight is pozentially more efficient than a corresponding (that is, structurally equivalent) swept wing. The single continuous wing panel also adapts itself more readily to varying angles of obliquity and hence to varying flight speeds. Work on the aerodynamics and flight stability of oblique-wing combinations is reviewed and a possible mode of application to transport aircraft operating at moderate supersonic speeds is suggested. Author

N72-13019*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
THE SECOND-GENERATION SUPERSONIC TRANSPORT
Mark R. Nichols, Arvid L. Keith, Jr., and Willard E. Foss, Jr. *In its* Vehicle Technol. for Civil Aviation 1971 p 409-428 refs (See N72-12995 04-02)
Avail: NTIS HC $6.00/MF $0.95 CSCL 01C

The impact on the second-generation supersonic transport of technology advances forecast for the 1975 to 1985 time period is considered. A number of areas are identified which offer the potential of major improvements in capabilities compared with the characteristics of the first-generation supersonic transports. When considered together, it is evident that the technical prognosis is good for the development of a well balanced second-generation aircraft that should be able to more than hold its own in the intercontinental air-transportation market of the 1980's. Author

N72-13020*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
HYPERSONIC TRANSPORTS
John V. Becker and Frank S. Kirkham *In its* Vehicle Technol. for Civil Aviation 1971 p 429-445 refs (See N72-12995 04-02)
Avail: NTIS HC $6.00/MF $0.95 CSCL 01C

Refinements for vehicle types which have already enjoyed massive developments are considered in large-scale support of hypersonic aircraft. An attempt is made to assess the implications bf these disciplinary advances for the hypersonic aircraft. In projecting some 20 years into the future, it is obviously appropriate that these assessments be uninhibited. Author

N72-13021# Federal Aviation Administration, Washington, D.C. Aviation Forecast Div.
LARGE AND MEDIUM HUB AVIATION ACTIVITY FORECAST, 1966 - 1982
Jul. 1971 43 p
(EC-200) Avail: NTIS

The forecasts of the large and medium hubs were summarized on two bases. The first is an alphabetical listing of large hubs followed by a similar listing for the medium hubs. Each of the five forecast series is shown separately. In addition, summaries and brief analyses of the rational used to develop individual air carrier forecasts were made for each FAA region showing the sum of large and medium hub activity by data series. Annual growth rates are shown along with each region's share of the national large and medium hub passenger enplanements and air carrier operations. Each region's projected share of national population and personal income is also shown based on data published by the National Planning Association. Author

N72-13022# Technology, Inc., Dayton, Ohio. Information Systems Div.
AIRLINE OPERATIONAL DATA FROM UNUSUAL EVENTS RECORDING SYSTEMS IN 707, 727, AND 737 AIRCRAFT
Interim Report, Jul. 1968 - Jun. 1971
Larry E. Clay, Robert C. DeLong, and Ronald I. Rockafellow Sep. 1971 151 p refs
(Contract dot-FA68WA-1906)
(FAA-RD-71-69; TI-273-71-4) Avail: NTIS CSCL 03C

To monitor the interaction between aircraft motion and pilot control inputs during such unusual happenings as upsets caused by turbulence and collision-avoidance type of maneuvers, unusual event recording systems (UERS) were installed in three jet transports: Boeing 707, 727, and 737 operated by two major airlines in scheduled passenger-carrying flights. The resultant 2088 hours of usable data demonstrated the adequacy of the UERS for extended monitoring of commercial aircraft flight parameters and revealed the potential of such data for providing statistical information. In addition to the usable operational data, data from 163 approaches recorded during 727 training flights were processed and presented. Data results indicated: that the three aircraft flew a little faster on landing approaches than the target speeds, that the airspeeds during flap extension and retraction frequently exceeded the limits with the frequency of exceedance varying with aircraft type, that the c.g. accelerations recorded in this program correlated well with those recorded on various aircraft types in a previous NASA program, that the 737 had a greater percentage of time in turbulence than the 707 and 727 in this program and twin-engine jet transports in the NASA program, and that sideslip angles with reverse rudder deflections usually occurred only at the lower airspeeds. Author

N72-13023# Toronto Univ. (Ontario). Inst. for Aerospace Studies.
A REVIEW OF THE STATUS OF AIR CUSHION TECHNOLOGY INCLUDING SUGGESTIONS FOR A CANADIAN RESEARCH AND DEVELOPMENT PROGRAMME
P. A. Sullivan and R. Placek May 1971 227 p refs
(UTIAS-33) Avail: NTIS

Research and development requirements for effective exploitation of air cushion technology in Canada is discussed. Detailed reviews of the status of two important applications, namely amphibious air cushion vehicles (ACV) or Hovercraft and tracked AVCs or Hovertrains, are given. An examination of the relationship of R & D to transportation vehicles is also included to provide a basis for taking an adequate perspective of needs in this new technology. Some recommendations on the form of an appropriate R & D program are also made in the light of trends in other fields. A summary of available information on amphibious AVC costs, and an annotated bibliography of the research literature together with a subject index are presented.
Author

N72-13024# Peat, Marwick, Mitchell and Co., Boston, Mass.
INTERCITY TRANSPORTATION EFFECTIVENESS MODEL
Technical Supplement to Final Report
William A. Jessiman and Donald E. Ward Dec. 1970 479 p refs
(Contract DOT-T8-542)
(PB-200470; T8-542-2) Avail: NTIS HC $6.00/MF $0.95 CSCL 01B

A supplement is presented for the intercity transportation effectiveness model. Author (GRA)

N72-13025# Peat, Marwick, Mitchell and Co., Boston, Mass.
INTERCITY TRANSPORTATION EFFECTIVENESS MODEL. DOCUMENTATION VOLUME 1: COMPUTER PROGRAM ORGANIZATION AND DESIGN SPECIFICATION
William A. Jessiman and Robert B. Cody Dec. 1970 368 p
(Contract DOT-T8-542)
(PB-200471; T8-542-3-Vol-1) Avail: NTIS HC $6.00/MF $0.95 CSCL 01B

The intercity transportation effectiveness computer programs are composed of a data base system, system executive, and the ITE model programs. The data base programs are used to create, update, and print the data base. The system executive is used to control the flow of inprocess data between the various programs of the ITE Model and to save intermediate and final results. The model programs are structured in five modules, namely, Passenger Demand, Cargo Demand, Routes, Network

Assignment, and Timetable Building. The system is programmed in extended Fortran 4 for execution on a CDC 6600 computer. A summary description of each module of the ITE model is given, together with general descriptions of the programs comprising each module. Brief descriptions of the suprograms comprising each program are also included. Author (GRA)

N72-13026# Peat, Marwick, Mitchell and Co., Boston, Mass.
INTERCITY TRANSPORTATION EFFECTIVENESS MODEL. DOCUMENTATION VOLUME 2: SUBPROGRAM DESIGN SPECIFICATION. BOOK 1: SECTIONS 1-25
William A. Jessiman and Robert B. Cody Dec. 1970 452 p
(Contract DOT-T8-542)
(PB-200472; T8-542-3-Vol-2-BK-1) Avail: NTIS HC $6.00/MF $0.95 CSCL 01B

Detailed descriptions of the programs contained in each module are given. These descriptions are composed of detailed writeups of the subprograms comprising each program. Operating system control cards and program tape organization are also discussed. Author (GRA)

N72-13027# Peat, Marwick, Mitchell and Co., Boston, Mass.
INTERCITY TRANSPORTATION EFFECTIVENESS MODEL. DOCUMENTATION VOLUME 2: SUBPROGRAM DESIGN SPECIFICATION. BOOK 2: SECTIONS 26-28
William A. Jessiman and Robert B. Cody Dec. 1970 405 p
(Contjact DOT-T8-542)
(PB-200473; T8-542-3-Vol-2-Bk-2) Avail: NTIS HC $6.00/MF $0.95 CSCL 01B

Detailed writeups of the routines which generate air routes and routings for use by the network assignment module are given. The route selection procedure and the routing generator program are described. Author (GRA)

N72-13028# Peat, Marwick, Mitchell and Co., Boston, Mass.
INTERCITY TRANSPORTATION EFFECTIVENESS MODEL. DOCUMENTATION VOLUME 2: SUBPROGRAM DESIGN SPECIFICATION. BOOK 3: SECTIONS 29-32
William A. Jessiman and Robert B. Cody Dec. 1970 498 p
(Contract DOT-T8-542)
(PB-200474; T8-542-3-Vol-2-Bk-3) Avail: NTIS HC $6.00/MF $0.95 CSCL 01B

Detailed writeups of the programs used to assign aircraft and selected routes to satisfy passenger and cargo demand at minimum social and economic cost are given. The airport access program which is used to evaluate the access characteristics of existing or proposed terminals and the daily traffic assignment model which determines the optimal allocation of aircraft and routings are described. The integer seeking program which converts fractional aircraft output of the DTAM to integer quantities and the route retrieval program which matches the routing output of integer seeking with the routes generated by the route selection program are considered. The cargo assignment program which assigns cargo demand to previously scheduled passenger flights is also described. Author (GRA)

N72-13029# Peat, Marwick, Mitchell and Co., Boston, Mass.
INTERCITY TRANSPORTATION EFFECTIVENESS MODEL. DOCUMENTATION VOLUME 2: SUBPROGRAM DESIGN SPECIFICATION. BOOK 4: SECTIONS 33-39
William A. Jessiman and Robert B. Cody Dec. 1970 334 p
(Contract DOT-T8-542)
(PB-200475; T8-542-3-Vol-2-Bk-4) Avail: NTIS HC $6.00/MF $0.95 CSCL 01B

The subprogram design specification for the intercity transportation effectiveness model is given. GRA

N72-13030# Peat, Marwick, Mitchell and Co., Boston, Mass.
INTERCITY TRANSPORTATION EFFECTIVENESS MODEL. DOCUMENTATION VOLUME 3: ACCEPTANCE TEST SPECIFICATIONS
William A. Jessiman and Robert B. Cody Dec. 1970 57 p
(Contract DOT-T8-542)
(PB-200476; T8-542-3-Vol-3) Avail: NTIS CSCL 01B

A description of the acceptance tests used to validate the capability of the programs to operate on real world airline networks is presented. The tests include running an 81-node network and performing 19 sensitivity tests on a subnetwork of approximately 25 nodes. Author (GRA)

N72-13031# Peat, Marwick, Mitchell and Co., Boston, Mass.
INTERCITY TRANSPORTATION EFFECTIVENESS MODEL. DOCUMENTATION VOLUME 6: CODING SPECIFICATIONS. BOOK 1: SECTIONS 1, 2
William A. Jessiman and Robert B. Cody Dec. 1970 15 p
(Contract DOT-T8-542)
(PB-200477; T8-542-3-Vol-6-Bk-1) Avail: NTIS CSCL 01B

Computer subprogram listings, load maps, and flow charts are presented for the intercity air transportation model. Author (GRA)

N72-13032# Peat, Marwick, Mitchell and Co., Boston, Mass.
INTERCITY TRANSPORTATION EFFECTIVENESS MODEL. DOCUMENTATION VOLUME 7: COMPUTER OPERATOR'S MANUAL
William A. Jessiman and Robert B. Cody Dec. 1970 55 p
(Contract DOT-T8-542)
(PB-200478; T8-542-3-Vol-7) Avail: NTIS CSCL 01B

Computer operator instructions and a list of program stops encountered in each program are presented for an intercity air transportation effectiveness model. Author (GRA)

N72-13033# Peat, Marwick, Mitchell and Co., Boston, Mass.
INTERCITY TRANSPORTATION EFFECTIVENESS MODEL. DOCUMENTATION VOLUME 8: COMPUTER PROGRAMMER'S MANUAL. BOOK 1: SECTIONS 1-25
William A. Jessiman and Robert B. Cody Dec. 1970 450 p
(Contract DOT-T8-542)
(PB-200479; T8-542-3-Vol-8-Bk-1) Avail: NTIS HC $6.00/MF $0.95 CSCL 01B

Detailed descriptions are given of the programs contained in each module of the intercity air transportation model. These are composed of writeups of the subprograms comprising each program. The writeup contains an abstract, input data and format specification, logic flow, output description, programming notes, and a listing bf program tables and variables. Operating system control cards and program tape organization are also discussed. Author (GRA)

N72-13034# Peat, Marwick, Mitchell and Co., Boston, Mass.
INTERCITY TRANSPORTATION EFFECTIVENESS MODEL. DOCUMENTATION VOLUME 8: COMPUTER PROGRAMMER'S MANUAL. BOOK 2: SECTIONS 26-28
William A. Jessiman and Robert B. Cody Dec. 1970 404 p
(Contract DOT-T8-542)
(PB-200480; T8-542-3-Vol-8-BK-2) Avail: NTIS HC $6.00/MF $0.95 CSCL 01B

Detailed writeups of the routines which generate air routes and routings for use by the network assignment module are presented. The route selection procedure, and the routing generator program are also described. Author (GRA)

N72-13035# Peat, Marwick, Mitchell and Co., Boston, Mass.
INTERCITY TRANSPORTATION EFFECTIVENESS MODEL. DOCUMENTATION VOLUME 8: COMPUTER PROGRAMMER'S MANUAL. BOOK 3: SECTIONS 29-32
William A. Jessiman and Robert B. Cody Dec. 1970 498 p
(Contract DOT-T8-542)
(PB-200481; T8-542-3-Vol-8-BK-3) Avail: NTIS HC $6.00/MF $0.95 CSCL 01B

Detailed writeups are presented of the programs used to assign aircraft and selected routes to satisfy passenger and cargo

demand at minimum social and economic cost. The airport access program which is used to evaluate the access characteristics of existing or proposed terminals is described. The daily traffic assignment model (DTAM) which determines the optimal allocation of aircraft and routings and the integer seeking program which converts fractional aircraft output of the DTAM to integer quantities are discussed. The route retrieval program which matches the routing output of the integer seeking with the routes generated by the route selection program and the cargo assignment program which assigns cargo demand to previously scheduled passenger flights are reviewed. Author (GRA)

N72-13036# Peat, Marwick, Mitchell and Co., Boston, Mass.
INTERCITY TRANSPORTATION EFFECTIVENESS MODEL. DOCUMENTATION VOLUME 8: COMPUTER PROGRAMMER'S MANUAL. BOOK 4: SECTIONS 33-39
William A. Jessiman and Robert B. Cody Dec. 1970 333 p refs See also Vol. 8, Book 3, PB-200481
(Contract DOT-T8-542)
(PB-200482; T8-542-3-Vol-8-Bk-4) Avail: NTIS HC $6.00/MF $0.95 CSCL 01B

Seven sections of the computer programmer's manual for the intercity transportation effectiveness model are presented. GRA

N72-13037# Watervliet Arsenal, N.Y.
THE TRANSIENT AEROELASTIC RESPONSE OF ROTOR
Eugene J. Brunelle and Struan R. Robertson Jun. 1971 46 p refs
(DA Proj. 1F0-61102-A-35-D)
(AD-728818; WVT-7141; AMCMS-CODE-501B.11.35D00.01) Avail: NTIS CSCL 01/3

The theorems of variational mechanics are employed to derive the equations of transient motion of a helicopter rotor in axial flight. Bending, torsion, and flapping motions are permitted. The resulting equations are solved approximately by means of a modified Galerkin technique and yield frequencies and damping ratios for given rotor parameters and a given rotor angular velocity. A parametric study of the variables is made and the results are discussed with particular reference to the damping ratios dependence on the rotor parameters. Author (GRA)

N72-13038# Navy Electronics Lab., San Diego, Calif.
NOISE LEVELS ON AIRCRAFT-CARRIER FLIGHT DECKS, AND THEIR EFFECTS Research and Development Report, 1 Jul. - 31 Dec. 1970
J. C. Webster 30 Apr. 1971 48 p
(NZLC Proj. B505; SF Proj. 14-224-001)
(AD-729067; NELC-TR-1762) Avail: NTIS CSCL 20/1

Measurements were made of noise levels produced by four aircraft during pilot qualification exercises aboard the flight deck of USS KITTY HAWK. These measurements, on both the A- and C- frequency weighting networks, were augmented by calculations of speech-interference levels made later from tape recordings. These data were compared to similar measurements made at the Naval Air Test Center at Patuxent River, Md., and interpreted in terms bf deafness risk and interference with speech communications. The levels measured on the carrier showed large amounts of low-frequency energy (at octaves centered at 62 and 125 Hz) not present in the data taken ashore; this variation is ascribed to the presence of blast deflectors on the carrier and to the effects of strong wind across the deck and the measuring microphone in its wind-screen. The noise levels measured are shown to severely degrade speech communications and to present a risk of deafness to personnel. Author (GRA)

N72-13039# Douglas Aircraft Co., Inc., Long Beach, Calif.
DEVELOPMENT OF A GRAPHITE HORIZONTAL STABILIZER Semiannual Interim Technical Report, 1 Nov. 1970 - 30 Apr. 1971
George M. Lehman, A. V. Hawley, F. C. Allen, and P. T. Mikkelson Jul. 1971 215 p refs
(Contract N00156-70-C-1321)
(AD-729050; MDC-J5169) Avail: NTIS CSCL 01/3

Testing of the graphite composite I-beam and box-beam components was completed and the test results were interpreted to indicate design modifications needed in the graphite stabilizers. Theoretical bending and torsional deflections of the box-beam compared favorably with test results. Allowable stresses in compression, shear, tension, and bearing were measured and deduced from test results and used to re-assess margins-of-safety in the stabilizer design. Margins-of-safety in compression and shear were judged adequate throughout the stabilizer. Negative margins-of-safety in combined tension and shear were determined in two localized areas of the upper skin panel near station X = 9.000 at the bolted attachments bf the front and rear-spars. Pin-bearing strengths were adequate to transmit ultimate loads, but the fiberglass grid element appeared susceptible to bearing damage at somewhat lower loads, especially under fatigue conditions. Design modification optiofs to eliminate the negative margins-of-safety involved the local reinforcing of the upper skin panel (with attendent changes to substructure components and tooling) or the use of bonding in addition to bolting for attachment of the upper panel. After evaluation of the two design options, the use of bolting and bonding was selected on the basis of reduced weight, increased strength and reliability, and minimum impact on detail design, tooling, schedule, and costs. Author (GRA)

N72-13040# Tactical Air Command, Langley AFB, Va. Office of Operations Analysis.
STOL TRANSPORT PARAMETERS (MILITARY AND COMMERCIAL) WITH SPECIAL EMPHASIS ON NOISE
George W. Stickle and Bobby G. Batten May 1971 149 p refs
(AD-729184; TAC-OA-TR-70-17) Avail: NTIS CSCL 01/3

A short handbook approach relating physical and environmental selection parameters to STOL transport capability is provided. It reviews existing laws and regulations on transport noise abatement. It reviews the noise from turbofan powered transports and discusses the future research and development trends and needs. It provides an indepth analysis of free turbine turbopropeller noise abatement providing engineering formulas, examples, and experimental data. Author (GRA)

N72-13041# McDonnell Aircraft Corp., St. Louis, Mo.
SURVIVABLE FLIGHT CONTROL SYSTEM. STUDIES, ANALYSES, AND APPROACH. SUPPLEMENT FOR CONTROL LAW DEVELOPMENT STUDIES Interim Report, Jul. 1969 - May 1971
Robert Kisslinger and George J. Vetsch Wright-Patterson AFB, Ohio. AFFDL May 1971 379 p refs
(Contract F33615-69-C-1827; AF Proj. 680J)
(AD-729207; AFFDL-TR-71-20-Suppl-2) Avail: NTIS HC $6.00/MF $0.95 CSCL 01/3

The Survivable Flight Control System (SFCS) Program is an advanced development program of which the principal objective is the development and flight test demonstration of an SFCS utilizing Fly-By-Wire and Integrated Actuator Package techniques. The studies and analyses conducted to date have sufficiently defined the system requirements to provide a definition of an approach to the implementation of the SFCS. The results of these studies and the definition of the approach are presented in the basic report. The details of the Control Criteria, and Hydraulic Power and Actuation studies are presented in report supplements 1 and 3, respectively. The results of the Control Law Development studies are presented in this supplement 2. Author (GRA)

03 AUXILIARY SYSTEMS

Includes fuel cells, energy conversion cells, and solar cells; auxiliary gas turbines; hydraulic, pneumatic and electrical systems; actuators; and inverters. For related information see also: 09 Electronic Equipment; 22 Nuclear Engineering; and 28 Propulsion Systems.

N72-13042 National Lending Library for Science and Technology, Boston Spa (England).
NEW DETERMINATION OF THE TEMPERATURE DEPENDENCE OF THE EMF OF THE INTERNATIONAL WESTON CELL IN THE RANGE 10 TO 30 C
M. Froelich, F. Melchert, and O. Steiner 22 Sep. 1971 17 p refs Transl. into ENGLISH from Metrologia (Heidelburg), no. 7, 1971 p 58
(NLL-T-7060-(5809.95)) Avail: Natl. Lending Library, Boston Spa, Engl.: 2 NLL photocopy coupons

Results of measurements and their computerized evaluation show that for all the cells in the temperature range 10 to 30 C the temperature dependence of EMF is independent of whether the temperature is changed in 1K or 5K steps. The most appropriate mathematical approximation for the variation of the EMF is a third order function. Temperature coefficients of EMF must be determined individually if the EMF at a temperature other than 20 C has to be known to within a microvolt or better. Author

N72-13043*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DEVELOPMENT AND PERFORMANCE OF PULSE-WIDTH-MODULATED STATIC INVERTER AND CONVERTER MODULES
Paul F. Pittman, Francis Gourash, Arthur G. Birchenough, Paul F. Pittman, Richard J. Ravas, and William G. Hall Washington Dec. 1971 70 p refs
(NASA-TN-D-6511; E-6212) Avail: NTIS CSCL 10B

Pulse-width-modulated inverter and converter modules are being developed for modular aerospace electrical power systems. The modules, rate 2.5 kilowatts per module and 10-minute - 150-percent overload, operate from 56 volts dc. The converter module provides two output voltages: a nominal link voltage of 200 volts dc when used with the inverter, and 150 volts dc to a load bus when used separately. The inverter module output is 400-hertz, sinusoidal, three-phase, 120/208 volts. Tests of breadboard models with standard parts and integrated circuits show rated power efficiencies of 71.4 and 85.1 percent and voltage regulation of 5 and 3.1 percent for inverter and converter modules, respectively. Sine-wave output distortion is 0.74 percent. Author

N72-13044*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
VOLTAGE-PROGRAMED CONTROL OF TURBOALTERNATOR LOAD
Richard N. Young and Eugene L. Kelsey Washington Dec. 1971 12 p refs
(NASA-TN-D-6578; L-7963) Avail: NTIS CSCL 10B

A power source and load-control concept was designed and tested for use with a Brayton cycle turboalternator. The concept provides power that adjusts to a range of loads while controlling alterfator speed and isolating load-switching transients. The concept is also applicable to power-generating sources other than the Brayton cycle. Author

N72-13045*# Rocketdyne, Canoga Park, Calif.
PRELIMINARY DESIGN OF AN AUXILIARY POWER UNIT FOR THE SPACE SHUTTLE: COMPONENT AND SYSTEM CONFIGURATION SCREENING ANALYSIS
R. L. Binsley, J. P. Maddox, R. D. Marcy, R. S. Siegler, and R. Spies Washington NASA Nov. 1971 298 p
(Contract NAS3-14407)
(NASA-CR-1928; TMRO115-3137) Avail: NTIS CSCL 10B

The auxiliary power unit (APU) for the space shuttle is required to provide hydraulic and electrical power on board the booster and orbiter vehicles. Five systems and their associated components, which utilize hot gas turbines to supply horsepower at gearbox output pads, were studied. Hydrogen-oxygen and storable propellants were considered for the hot gas supply. All APU's were required to be self-contained with respect to dissipating internally generated heat. These five systems were evaluated relative to a consistent criteria. The system supplied with high pressure gaseous hydrogen and oxygen was recommended as the best approach. It included a two-stage pressure-compounded partial-admission turbine, a propellant conditioning system with recuperation, a control system, and a gearbox. The gearbox output used was 240 hp. At the close of the study a 400 hp level was considered more appropriate for meeting the prime shuttle vehicle needs, and an in-depth analysis of the system at the 400 hp output level was recommended. Author

N72-13046*# Electro-Optical Systems, Inc., Pasadena, Calif.
DEVELOPMENT OF LIGHTWEIGHT ALUMINUM HOLLOWCORE SOLAR CELL ARRAY TECHNOLOGY
J. A. Carlson [1971] 103 p refs
(Contract NAS1-9495)
(NASA-CR-112002; FR-4045) Avail: NTIS CSCL 10A

A baseline configuration for a three section folding array, with retraction capability, was developed which would utilize electroformed aluminum hollowcore substrates and beryllium frames. The three section array was not fabricated because of difficulties with impurities in the aluminum electroforming bath. A procedure was developed for etching the copper mandrel from virtually any size of aluminum hollowcore panel in approximately one hour. Procedures were developed for analyzing the content of peroxide, water, total aluminum, and lithium-aluminum-hydride in an aluminum electroforming solution. Author

N72-13047# Joint Publications Research Service, Washington, D.C.
COMPARISON OF THE EFFECTIVENESS OF GaAs AND Si SOLAR BATTERIES ON SPACECRAFT IN THE INTERVAL OF 0.2 - 10 ASTRONOMICAL UNITS
M. B. Kagan, A. P. Landsman, and T. L. Lyubashevskaya 10 Jan. 1972 17 p refs Transl. into ENGLISH from Kosm. Issled. (USSR), v. 9, no. 4, 1971 p 592-600
(JPRS-54892; UDC-621.311.6:621.472) Avail: NTIS

Theoretical and experimental investigations of the work of GaAs solar batteries under working conditions aboard spacecrafts in the interval of 0.2-10 a.u. were conducted. It was established that with equal initial efficiency of the GaAs elements and elements of Si (illumination density 1400 watt/sq m, T 30 C), GaAs solar batteries possessed greater specific power over the whole investigated distances to the sun. Author

N72-13048# Naval Nuclear Power Unit, Fort Belvoir, Va.
RADIOISOTOPIC POWER DEVICES OF THE US NAVY, VOLUME 5, NUMBER 2 Quarterly Operating Report, 1 Apr. - 30 Jun. 1971
30 Jun. 1971 49 p refs
(AD-728749) Avail: NTIS CSCL 10/2

Three new 25 watt and four 10 watt generators were added to the Navy inventory during this quarter and a contract for four additional 1 watt RPGs was awarded to the Gulf General Atomic Company. The annual parametric testing/health physics support visit to Fairway Rock, Alaska, site of the oceanographic data collection and telemetering system which has been powered by RTG-1 since August 1966, was accomplished in mid June and it was confirmed that the generator is still delivering in excess of 18 watts to the load. The Naval Underwater Research and Development Center's internal wave experiment system powered by RTGs-4 and -14 was

successfully placed in operation off Mission Beach, California on 21 June. Author (GRA)

N72-13049# Naval Underwater Systems Center, Newport, R.I.
OCEAN ACRE 10: A REPORT OF THE CRUISE AND SOME PRELIMINARY OBSERVATIONS
Charles L. Brown, Jr. 20 Mar. 1971 21 p refs
(NUSC Proj. A-4000-03-00)
(AD-725114; NUSC-4085; Task-SE-11-552-101-12856; NAVSHIPS-00V1; Code-TA131) Avail: NTIS CSCL 08/1

Ocean Acre 10 was more successful than the previous nine Ocean Acre cruises for the following reasons: (1) discrete biological samples were obtained at all sampling depths to 1150 M, day and night, (2) acoustic measurements were taken to obtain scattering strengths during all periods of the day, (3) a direct correlation was obtained between acoustic and biological data, and (4) an improved biological net operating system was used successfully for the first time. When the data are analyzed, the results will be a significant contribution to the understanding of biological reverberation. Author (GRA)

04 BIOSCIENCES

Includes aerospace medicine, exobiology, radiation effects on biological systems; physiological and psychological factors. For related information see also: 05 Biotechnology.

N72-13050*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
EFFECTS OF INHALATION OF FREON 113 ON LABORATORY ANIMALS
Vernon L. Carter, Paul M. Chikos, James D. MacEwen (SysteMed Corp., Wright-Patterson AFB, Ohio), and Kenneth C. Back (AMRL, Wright-Patterson AFB, Ohio) Dec. 1970 18 p
(NASA-TM-X-67461; AD-727524; AMRL-TR-70-102-20) Avail: NTIS CSCL 06T

Four monkeys, 8 dogs, 40 mice, and 50 rats were exposed continuously to 2000 ppm Freon 113 in a Thomas Dome for 14 days. This exposure produced no mortalities nor adverse symptomology. There were no significant alterations in hematologikal values, clinical chemistries, electroencephalographic findings, body weights, or organ to body weight ratios. The effect of 2% Freon 113 on nicotinic transmission through the stellate ganglion of the spinal dog was also evaluated. The exposure induced a reduction in nicotinic transmission comparable to 2% halothane. Author

N72-13051*# Biospherics, Inc., Rockville, Md.
AUTOMATED MICROBIAL METABOLISM LABORATORY Annual Report, 1971
19 Oct. 1971 134 p refs
(Contract NASw-1931)
(NASA-CR-124691) Avail: NTIS CSCL 14B

The effect of several environmental parameters on previously developed life detection systems is explored. Initial attempts were made to conduct all the experiments in a moust mode (high soil volume to water volume ratio). However, only labeled release and measurement of ATP were found to be feasible under conditions of low moisture. Therefore, these two life detection experiments were used for most of the environmental effects studies. Three soils, Mojave (California desert), Wyaconda (Maryland, sandy loam) and Victoria Valley (Antarctic desert) were generally used throughout. The environmental conditions studied included: incubation temperature 3 C to 80 C, ultraviolet irradiation of soils, variations in soil/liquid ratio, specific atmospheric gases, various antimetabolites, specific substrates, and variation in pH. An experiment designed to monitor nitrogen metabolism was also investigated. Author

N72-13052# Academy of Sciences (USSR), Moscow.
METHODS OF SEPARATING BIOLOGICALLY IMPORTANT UNITS FROM THE ORGANIC MATTER IN SOILS
G. A. Lavrentyev 1971 34 p refs In RUSSIAN
(PR-60) Avail: NTIS

Organic materials in soils were studied for C, N, and P content. Solutions of $Na_4P_2O_7$, Na_3PO_4, HCl, Na_2CO_3, NaOH, HF, and EDTA-Na2 were used for the extractions of various organic elements. The effectiveness of the different reagents in removal of the amino acids glycine, aspartic acid, valine, leucine, alanine, glutamic acid, and treonine was investigated. Nucleic acids, nucleotides, xanthine, hypoxanthine, and various enzymes, as well as DNA and RNA, were also considered. It was concluded that the effectiveness of extraction was directly proportional to the pH and the complex-forming ability of the ions in the extracting reagent. Transl. by K.P.D.

N72-13053*# Michigan Univ., Ann Arbor. Research Center for Group Dynamics.
ORGANIZATIONAL STRESS AND INDIVIDUAL STRAIN: A SOCIAL-PSYCHOLOGICAL STUDY OF RISK FACTORS IN CORONARY HEART DISEASE AMONG ADMINISTRATORS, ENGINEERS, AND SCIENTISTS Cumulative Progress Report, 1 Jul. 1969 - 30 Jun. 1970
Robert Dennis Caplan Nov. 1971 691 p refs
(Grant NGR-23-005-185)
(NASA-CR-125217) Avail: NTIS HC $9.00/MF $0.95 CSCL 06S

It is hypothesized that organizational stresses, such as high quantitative work load, responsibility for persons, poor relations with role senders, and contact with alien organizational territories, may be associated with high levels of psychological and physiological strain which are risk factors in coronary heart disease. It is further hypothesized that persons with coronary-prone Type A personality characteristics are most likely to exhibit strain under conditions of organizational stress. Measures of these stresses, personality traits, and strains were obtained from 205 male NASA administrators, engineers, and scientists. Type A personality measures included sense of time urgency, persistence, involved striving, leadership, and preference for competitive and environmentally overburdening situations.
Author

N72-13054# Royal Aircraft Establishment, Farnborough (England).
DELAYED REACTIONS IN HUMANS
Ziemowit Wlodarski Jan. 1971 21 p refs Transl. into ENGLISH from Przegl. Psychologiczny (Poland), no. 2, 1958 p 57-69
(RAE-Lib-Tran-1498; BR25162) Avail: NTIS

Experiments involving enforced delay of response to stimuli in a choice situation are widely used in research on memory and higher mental processes. At the time that the response is actually made the stimuli are no longer present. A number of research findings are reviewed. The success of the response following delay depends on a great variety of factors including length of delay, species and stage of development of the subject and presence of mediating cues, e.g. color. For human adults and older children the amount of tolerable delay may be regarded as unlimited. Author

N72-13055*# Battelle-Northwest, Richland, Wash. Pacific Northwest Lab.
THE MEASUREMENT OF RADIATION EXPOSURE OF ASTRONAUTS BY RADIOCHEMICAL TECHNIQUES Quarterly Research Report, 4 Jan. - 4 Apr. 1971
R. L. Brodzinski 15 Apr. 1971 45 p refs Sponsored by NASA
(Contract AT(45-1)-1830)
(NASA-CR-124713; BNWL-1183-8) Avail: NTIS CSCL 06R

The concentrations of 23 major, minor, and trace elements in the fecal samples from the Apollo 12 and 13 astronauts are reported. Most elemental excretion rates are comparable to rates

reported for earlier missions. Exceptions are noted for calcium, iron, and tin. Body calcium and iron losses appear to be reduced during the Apollo 12 and 13 missions such that losses now seem to be insignificant. Refined measurements of tin excretion rates agree with normal dietary intakes. Earlier reported tin values are in error. A new passive dosimetry canister was designed which contains foils of tantalum, copper, titanium, iron, cobalt, aluminum, and scandium. By measuring the concentrations of the various products of nuclear reactions in these metals after space exposure, the characteristics of the incident cosmic particles can be determined. Author

N72-13056*# ABT Associates, Inc., Cambridge, Mass.
APPLICATIONS OF AEROSPACE TECHNOLOGY IN BIOMEDICINE. A TECHNOLOGY TRANSFER PROFILE: PATIENT MONITORING
Donald M. Murray Sep. 1971 36 p refs
(Contract NASw-2022)
(NASA-CR-124817) Avail: NTIS CSCL 06E

NASA contributions to cardiovascular monitoring are described along with innovations in intracardiac blood pressure monitoring. A brief overview of the process of NASA technology transfer in patient monitoring is presented and a list of bioinstrumentation tech briefs and the number of requests for technical support is included. F.O.S.

N72-13057*# John B. Pierce Foundation of Connecticut, New Haven.
DEVELOPMENT OF MATHEMATICAL MODELS OF ENVIRONMENTAL PHYSIOLOGY Final Report
Jan A. J. Stolwijk, John W. Mitchell, and Ethan R. Nadel [1971] 173 p refs
(Contract NAS9-9531)
(NASA-CR-115268; FR-B) Avail: NTIS CSCL 06P

Selected articles concerned with mathematical or simulation models of human thermoregulation are presented. The articles presented include: (1) development and use of simulation models in medicine, (2) model of cardio-vascular adjustments during exercise, (3) effective temperature scale based on simple model of human physiological regulatory response, (4) behavioral approach to thermoregulatory set point during exercise, and (5) importance of skin temperature in sweat regulation. F.O.S.

N72-13058*# Beckman Instruments, Inc., Fullerton, Calif. Advanced Technology Operations.
PROTOTYPE SLIDE STAINER Final Report
Aug. 1971 65 p
(Contract NAS9-11929)
(NASA-CR-115264; FR-1086-101) Avail: NTIS CSCL 06M

The prototype slide staining system capable of performing both one-component Wright's staining of blood smears and eight-step Gram staining of heat fixed slides of microorganisms is described. Attention was given to liquid containment, waste handling, absence of contamination from previous staining, and stability of the staining reagents. The unit is self-contained, capable of independent operation under one- or zero-g conditions, and compatible with Skylab A. Author

N72-13059*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
BIBLIOGRAPHY: CODES, STANDARDS, PROCEDURES, SPECIFICATIONS AND REPORTS RELATING TO CONTAMINATION CONTROL
Francis N. Ledoux Jun. 1970 54 p refs
(NASA-TM-X-63982; X-723-70-220) Avail: NTIS CSCL 11K

The bibliography is arranged in separate sections under headings that include: (1) spacecraft cleanliness, (2) general cleaning, (3) clean room and work stations, (4) contamination, (5) decontamination, (6) manufacturing, (7) miscellaneous, (8) particle count analysis, (9) passivation, (10) packaging, (11) water, and (12) acids and detergents. D.L.G.

N72-13060*# SysteMed Corp., Dayton, Ohio.
TOXIC HAZARDS RESEARCH UNIT Annual Technical Report, Jun. 1970 - May 1971
J. D. MacEwen and E. H. Vernot Wright-Patterson AFB, Ohio AMRL Oct. 1971 29 p refs
(NASA Order T-80498; Contract F33615-70-C-1046)
(NASA-CR-124835; Task-01; ATR-7; W-71004; AMRL-TR-71-83) Avail: NTIS CSCL 06T

The activities of the Toxic Hazards Research Unit (THRU) for the period of June 1970 through May 1971 reviewed. Modification of the animal exposure facilities primarily for improved human safety but also for experimental integrity and continuity are discussed. Acute toxicity experiments were conducted on hydrogen fluoride (HF), hydrogen chloride (HCl), nitrogen dioxide (NO2), and hydrogen cyanide (HCN) both singly and in combination with carbon dioxide (CO). Additional acute toxicity experiments were conducted on oxygen difluoride (OF2) and chlorine pentafluoride (ClF5). Subacute toxicity studies were conducted on methylisobutylketone and dichloromethane (methylene dichloride). The interim results of further chronic toxicity experiments on monomethylhydrazine (MMH) are also described. Author

N72-13061# Civil Aeromedical Inst., Oklahoma City, Okla.
THE ACUTE TOXICITY OF BRIEF EXPOSURES TO HF, HC1, NO2 AND HCN SINGLY AND IN COMBINATION WITH CO
E. Arnold Higgins, Vincent Fiorica, A. A. Thomas (AMRL), and Harvey V. Davis (Standard Oil Co., Chicago) Nov. 1971 10 p refs
(Contract Dot-1AC-60027-D)
(FAA-AM-71-41; Task-AM-B-71-PHY-41) Avail: NTIS

Experiments were conducted with animals to determine the toxic effect of short-term exposures to some of the products produced in aircraft fires. The products were tested both singly and in combination with carbon monoxide. The studies show the toxicity rankings of the four materials tested to be HNC, NO2, HF and HC1, in decreasing order. Carbon monoxide concentrations which alone are not hazardous to life do not enhance the toxic response to these substances. Author

N72-13062*# Translation Consultants, Ltd., Arlington, Va.
GLYCOLYSIS IN ADENOVIRUS INFECTED RAT CELL CULTURES AND IN ADENOVIRUS TYPE 12 INDUCED HAMSTER SARCOMA CELLS
A. I. Ageyenko, N. M. Kholmukhamedova, V. T. Rimofeyev, I. Ya. Kogan, and A. N. Saprin Washington NASA Dec. 1971 9 p refs Transl. into ENGLISH of "Glikoliz Krysinykh Kulitur, Zarazhennykh Adenovirusom, i Kletok Sarkom A-12 Khomyakov", Vop. Onkol. (USSR), v. 16, no. 9, 1970 p 49-53
(Contract NASw-2038)
(NASA-TT-F-14061) Avail: NTIS CSCL 06P

It was demonstrated that in cultures of fibroblasts of rat embryos (REF) infected with human adenoviruses, statistically reliable ($p > or = 0.00$) increase of glycolytic reactions in contrast with the control, depending on types of inoculated viruses were observed. Cultures of REF cells, infected with oncogenic adenovirus, type 12, were characterized by more pronounced aerobic and anaerobic glycolysis than REF cultures infected with adenovirus, types 3 and 6. Cells of rat fibroblasts infected with human, adenovirus utilize glucose under aerobic conditions more intensively in comparison with control ones. There were noted identical shifts in glycolytic reactions in REF cell cultures infected with adenovirus, type 12, and in cells of hamster sarcoma A-12 cultivated in vitro. Author

N72-13063# Oak Ridge Associated Universities, Tenn. Medical Div.
[BIOMEDICAL RESEARCH ON RADIATION EFFECTS] Research Report, Year Ending 31 Dec. 1970
31 Dec. 1970 216 p refs Sponsored by AEC
(ORAU-113) Avail: NTIS

The effectiveness of radioisotope scanning of Ga-67 for the

localization of neoplasms in lymphatic tissues was evaluated. The uptake of Ga-67 in human tissues obtained at autopsy and in 22 different types of rat, hamster, and mouse tumors was studied. The radiation dose to human spleen, kidneys, adrenal glands, bone marrow, and liver at various times following the administration of tracer doses of Ga-67 was measured. The development of computer data analysis and recording systems for the analysis and storage of information of effects of whole-body irradiation on man and for the analysis of data from clinikal radioisotope diagnostic tests is discussed. NSA

N72-13064# United Kingdom Atomic Energy Authority, Harwell (England).
HEALTH PHYSICS AND MEDICAL DIVISION Progress Report, Jan. - Dec. 1970
J. E. Johnston, ed. May 1971 66 p refs
(AERE-PR/HPM-15) Avail: AEC Depository Libraries; HMSO 55p; PHI $2.35

Research projects reported include, (1) aerosol research, (2) human metabolic studies; (3) whole-body counting, (4) occupational hygiene, (5) collaborative work with medical research laboratories, (6) operational techniques in radiation protection, (7) atmospheric pollution, (8) radiation physics, (9) neutron dosimetry and radiobiophysics, (10) personnel dosimetry service, (11) kellular radiobiology, (12) radiation spectrometry and computer processing, (13) fallout, (14) environmental analysis, (15) soil radioecology, and (16) biological applications of radiation processing and radiology. A list of 71 papers and reports issued during the year is included. NSA

N72-13065# Air Force Academy, Colo.
CROSS-SENSORY EFFECTS OF WHITE NOISE ON COLOR PERCEPTION
Lloyd R. Chason and Gene A. Berry May 1971 26 p refs
(AD-728199; USAFA-RR-71-6) Avail: NTIS CSCL 06/16

The perceived intensity of red, green and blue lights was measured under conditions of dark-adaptation or nondark-adaptation and silence or 100 dB white noise. Sixty male subjects were randomly assigned over twelve experimental cells and required to match a colored light to a white standard. No significant differences were found between dark-adaptation and mondark-adaptation. Significant differences were found between the silence and noise conditions (p +.01) and between the three colors (+.001). Light sensitivity or perceived intensity was increased under the white noise conditions. The data are viewed as supporting theories of sensory interaction stressing the importance of considering vision and hearing as interactive systems. Possible implications in human engineering design and subsequent research efforts are discussed. Author (GRA)

N72-13066# Pennsylvania Univ., Philadelphia. School of Medicine.
HISTOPATHOLOGY OF ARGON LASER-INDUCED RETINAL LESIONS Annual Progress Report, 1 Aug. 1970 - 31 Jul. 1971
Myron Yanoff Aug. 1971 10 p refs
(Contract DADA17-70-C-0011)
(AD-728333; APR-2) Avail: NTIS CSCL 06/5

The purpose of the project was to obtain information on the biologic effects of the argon laser on the retina. In addition, the biological retinal effects of other lasers (ruby, gallium arsenide, neodymium and carbon dioxide) were carried out. After owl and rhesus monkeys were exposed to one or more of the above lasers, serial sections were cut with a microtome through the suspect retinal areas in order to determine the presence or absenke of retinal damage. The pigment epithelium was the most sensitive area of the retina exposed to threshold argon and ruby laser energies. The photoreceptor and outer nuclear layers were the next most sensitive retinal areas exposed to argon radiation. Author (GRA)

N72-13067# Naval Medical Research Inst., Bethesda, Md.
A RADIOGRAPHIC METHOD FOR DEMONSTRATING DECOMPRESSION SICKNESS IN HAMSTERS
Wesley D. Ulrich, Benjamin E. Smith, Jr., and Thomas Hernandez 13 Jul. 1971 10 p
(AD-728396; NAVMED-M4306.01-1010BXK9-1) Avail: NTIS CSCL 06/19

The major vessels of the hind legs of male golden hamsters were examined with contrast angiography and air infusion angiography. The angiograms were compared with the intravascular gas patterns that were present on radiographs of hamsters with severe decompression sickness. Author (GRA)

N72-13068# Ballistic Research Labs., Aberdeen Proving Ground, Md. Nuclear Effects Lab.
VEGETATION DENSITY DETERMINATIONS BY GAMMA RAY ABSORPTION
Carmen M. Cialella and James G. Dante Jun. 1971 32 p ref
(AMCMS Proj. 5672.15.39800)
(AD-729319; BRL-MR-2101) Avail: NTIS CSCL 06/3

A method of nondestructive determination of vegetation density in place is presented. This method utilizes a gamma ray absorption technique. The 122 keV gamma rays from Cobalt 57 were used for this work. The determinations are made using the principle of narrow beam absorption, observing the attenuation of the gamma ray photopeak produced in a 7.62 cm dia. x 7.62 cm long solium-iodide scintillation crystal. Results of measurements performed at Eglin Air Force Base are included.
Author (GRA)

N72-13069# Naval Medical Research Inst., Bethesda, Md.
ANALYSIS OF THE PHYSIOLOGIC EFFECTS OF MICROWAVE RADIATION Interim Report
Byron D. McLees and Edward D. Finch Jun. 1971 74 p refs
(AD-728397; NAVMED-MF12.524.015-0001B; Rept-3) Avail: MTIS CSCL 06/18

An analysis of studies on the physiologic effects of animal exposure to microwave radiation is presented. Topics include: Electromagnetic waves as they interact with tissue; Technique of microwave irradiation and evaluation of exposure; Temperature changes induced by microwave radiation; Hematologic effects; Serologic changes; Changes in testicular structure and function; The effects of microwave radiation on the eye. GRA

N72-13952# Royal Swedish Academy of Engineering Sciences, Stockholm.
NEW KNOWLEDGE OF LIFE PROCESSES
In its Develop. in Res. and Technol. during 1970 1970 p 84-92 refs In SWEDISH (See N72-13942 04-34)
Avail: NTIS; Almqvist & Wiksell, Stockholm: 25 Kr

05 BIOTECHNOLOGY

Includes life support systems, human engineering; protective clothing and equipment; crew training and evaluation, and piloting. For related information see also: 04 Biosciences.

N72-13070*# Fairchild Hiller Corp., Farmingdale, N.Y. Republic Div.
DATA BOOK: SPACE STATION/BASE FOOD SYSTEM STUDY. BOOK 3: STUDY SELECTION RATIONALE SHEETS
31 Dec. 1970 193 p
(Contract NAS9-11139)
(NASA-CR-115232; MS128W0002-Bk-3; MSC-01816) Avail: NTIS CSCL 5C

The supporting rationale sheets are presented which were utilized in the selection and support of the concepts considered

in the final phase of the study. Each concept, conceived to fulfill a specific function of the food system, was assessed in terms of the eight critical factors depicted on the rationale sheet. When weighted and totaled, the resulting selection factor was used as a guide in making the final decision. D.L.G.

N72-13071*# ABT Associates, Inc., Cambridge, Mass.
APPLICATIONS OF AEROSPACE TECHNOLOGY IN INDUSTRY. A TECHNOLOGY TRANSFER PROFILE: FOOD TECHNOLOGY
Donald M. Murray Sep. 1971 56 p refs
(Contract NASw-2022)
(NASA-CR-124815) Avail: NTIS CSCL 06H

Food processing and preservation technologies are reviewed, expected technological advances are considered including processing and market factors. NASA contributions to food technology and nutrition are presented with examples of transfer from NASA to industry. F.O.S.

N72-13072*# Litton Systems, Inc., Beverly Hills, Calif. Applied Technology Div.
DEVELOPMENT OF A PORTABLE LIFE SUPPORT SYSTEM AND EMERGENCY LIFE SUPPORT PACK Final Report
13 Jun. 1970 112 p
(Contract NAS9-8135; Contract NAS9-8135)
(NASA-CR-108541; Publ-70-586; Publ-70-586) Avail: NTIS CSCL 06K

The design, development, and fabrication of a feasibility model of a breathing bag life support system for extravehicular activity are discussed. The breathing vest and back pack portable life support system contains connectors which allow external water and gas supply. At a metabolic rate of 2000 BTU per hour, the two low pressure bottles provide 27 mifutes of breathing gas for a total filled system weight of 30.5 pounds. Author

N72-13073# Joint Publications Research Service, Washington, D.C.
MEANS OF PENETRATING THE OCEAN
Genrikh Uovich Zaltsman 23 Dec. 1971 21 p refs Transl. into ENGLISH from Priroda (Moscow), no. 10, 1971 p 28-37
(JPRS-54789; UDC-557.4) Avail: NTIS

The physiological effects and limitations imposed on human subjects during deep water diving are discussed. Methods for preventing adverse effects by improved protective clothing and various gas mixtures for breathing are presented. The subject of saturation diving and living at great depths for extended periods of time is examined. A brief history of scientific expeditions by various countries to increase understanding of underwater physiology is included. P.N.F.

N72-13074*# International Business Machines Corp., Huntsville, Ala. Electronics Systems Center.
A GUIDE TO ONBOARD CHECKOUT. VOLUME 2: ENVIRONMENTAL CONTROL AND LIFE SUPPORT
Sep. 1971 63 p
(Contract NAS9-11189)
(NASA-CR-115260; IBM-71W-00309-Vol-2) Avail: NTIS CSCL 06B

A description of space station equipment for environmental control and life support is presented. Reliability and maintenance procedures are reviewed. Failure analysis and checkout tests are discussed. The strategy for software checkout is noted. K.P.D.

N72-13075*# Martin Marietta Corp., Denver, Colo.
EXPERIMENTAL SYSTEM FOR THE CONTROL OF SURGICALLY INDUCED INFECTIONS
M. D. Tevebaugh 1 Oct. 1971 32 p
(Contract NASw-2210)
(NASA-CR-124762; D203613-006; MCR-71-328) Avail: NTIS CSCL 06L

The development tests to be performed on the experimental system are described in detail. The test equipment, conditions, and procedures are given. The portable clean room tests include assembly, collapsability, portability, and storage; laminar flow rate; static pressure; air flow pattern; and electrostatic buildup. The other tests are on the ventilation system, human factors evaluation, electrical subsystem, and material compatibility. N.E.N.

N72-13076# Joint Publications Research Service, Washington, D.C.
TRAINING OF ASTRONAUTS ON LABORATORY AIRCRAFT UNDER CONDITIONS OF WEIGHTLESSNESS FOR LABOR ACTIVITY IN SPACE
Ye. V. Khrunov, I. F. Chekirda, and I. A. Kolosov 8 Dec. 1971 10 p refs Transl. into ENGLISH from Vopr. Psikhologii (Moscow), no. 5, 1971 p 30-36
(JPRS-54649) Avail: NTIS

The special training of astronauts in aircraft flight for later IVA and EVA in space is described. The general training procedures and the particular procedures during the final training stages are discussed. The complex activity of the astronaut as investigator and tester and the effect of performing activities in weightlessness environments are considered for evaluating the types of labor according to difficulty and reliability of astronaut performance. The change in motor skills under weightlessness conditions, and the engineering/psychological evaluation of astronaut activity are also discussed. N.E.N.

N72-13077*# Webb Associates, Yellow Springs, Ohio.
DEVELOPMENT OF A SPACE ACTIVITY SUIT
James F. Annis and Paul Webb Washington NASA Nov. 1971 138 p refs
(Contract NAS1-8018)
(NASA-CR-1892) Avail: NTIS CSCL 05E

The development of a series of prototype space activity suit (SAS) assemblies is discussed. The SAS is a new type of pressure suit designed especially for extravehicular activity. It consists of a set of carefully tailored elastic fabric garments which have been engineered to supply sufficient counterpressure to the body to permit subjects to breath O2 at pressures up to 200 mm Hg without circulatory difficulty. A closed, positive pressure breathing system (PPBS) and a full bubble helmet were also developed to complete the system. The ultimate goal of the SAS is to improve the range of activity and decrease the energy cost of work associated with wearing conventional gas filled pressure suits. Results are presented from both laboratory (1 atmosphere) and altitude chamber tests with subjects wearing various SAS assemblies. In laboratory tests lasting up to three hours, the SAS was worn while subjects breathed O2 at pressures up to 170 mm Hg without developing physiological problems. The only physiological symptoms apparent were a moderate tachycardia related to breathing pressures above 130 mm Hg, and a small collection of edema fluid in the hands. Both problems were considered to be related to areas of under-pressurization by the garments. These problems, it is suggested, can ultimately be corrected by the development of new elastic fabrics and tailoring techniques. Energy cost of activity, and mobility and dexterity of subjects in the SAS, were found to be superior to those in comparable tests on subjects in full pressure suits. Author

N72-13078*# Naval Air Development Center, Johnsville, Pa.
DETERMINATION OF SKIN TEMPERATURE UNDER A COMFORT-CONTROLLED LIQUID-COOLED GARMENT IN EXERCISING SUBJECTS Final Report
L. J. SantaMaria 26 Oct. 1971 17 p refs
(NASA Order T-91349)
(NASA-CR-115295; NADC-CS-7118) Avail: NTIS CSCL 05E

The physiological responses of exercising subjects were investigated under conditions in which the temperature of the coolant water was varied according to the subjective state of thermal comfort. Conditioning water was maintained at a

constant flow rate of 240 lb/hr and at a temperature controllable within the range of 45 to 90 F. In addition to skin temperatures, rectal temperature and heart rate were monitored in the course of each trial. Total and evaporative weight losses were determined by measurements before and after each test. The levels on xetabolic loading, measured indirectly on the basis of O2 consumption in the course of treadmill activity, ranged from the resting state to 2000 BTU/hr at increments of about 400 BTU. Under the experimental conditions, six volunteer subjects established a level of thermal comfort, as sensed subjectively, by controlling inlet water within the available range of temperature.
Author

N72-13079# Royal Aircraft Establishment, Farnborough (England).
THE EFFECT OF DAZZLE ON ELECTRONIC DISPLAY VISIBILITY IN MODERN HIGH-PERFORMANCE AIRCRAFT COCKPITS, A SUMMARY
Q. Jainski Mar. 1971 28 p Transl. into ENGLISH from Einfluss der Blendung auf das Erkennen Elektronischer Anzeigen in Kanzeln Moderner Hochleistungsflugzeuge. Kurzfassung; German Federal Ministry Defence report T-808-I-203
(RAE-LIB-TRANS-1545; T-808-I-203) Avail: NTIS
Data are presented for various effects on threshold light intensizy. A dazzle formula is developed. K.P.D.

N72-13080*# McDonnell-Douglas Astronautics Co., St. Louis, Mo.
CREW INTERFACE DEFINITION STUDY, PHASE 1 Pre-simulation Report
J. C. Callihan, J. W. Kraemer, and J. A. Alles 1 Oct. 1971 150 p refs
(Contract NAS9-12079)
(NASA-CR-124739; MDC-E0484) Avail: NTIS CSCL 05E
The tixeline analysis of the Shuttle orbiter missions which was conducted in the Phase I Crew Interface Definition Study and the requirements for the man-in-the-loop simulation study are presented. Mission definitions and objectives are presented as they relate to various Shuttle Orbiter missions. The requirements for crew participation and the information required by the crew are discussed, and finally the rationale behind the display concept and calling procedures is given. The simulation objectives, the simulation mechanization, including a detailed presentation bf the display and control concept, the simulator test plan and the results are discusseb. Author

N72-13081*# Northrop Nortronics, Palos Verdes Peninsula, Calif.
METHOD OF MAKING DRY ELECTRODES Patent Application
Frank B. Ramme, inventor (to NASA) Filed 7 Oct. 1970 13 p
(Contract NAS4-1133)
(NASA-Case-FRC-10029-2; US-Patent-Appl-SN-78704) Avail: NTIS CSCL 06D
Dry electrodes useful for attachment to individuals are made by mixing silver powder with a cement. The mixture is diluted with a suitable solvent for the cement and then applied in a thin layer to a surface from which it is removed as a film when dry. A wire lead is then placed on a cut film piece and a small amount of solvent is applied to the film surface where the wire rests. Subsequent pressing of a second piece of the dried film onto the substrate holding the wire forms the finished electrode.
NASA

N72-13082# National Aviation Facilities Experimental Center, Atlantic City, N.J.
REACTIONS OF PILOTS TO WARNING SYSTEMS FOR VISUAL COLLISION AVOIDANCE Final Report, Jul. 1969 - Jul. 1971
Paul M. Rich, Warren G. Crook, Richard L. Sulzer, and Peter R. Hill Dec. 1971 72 p refs
(Proj. 051-241-03x)
(FAA-NA-71-54; FAA-RD-71-61) Avail: NTIS
A series of six experiments was conducted that have application to the development of pilot warning instruments (PWI). The experiments were concerned with: (1) the effect of warning rates on pilot performance, (2) pilot response to imminent collision threats, (3) the evaluation of scanning patterns, (4) the value of warning-only, (5) the effect of relative motion on pilot performance, and (6) the effect of PWI display sector size. The results of these experiments offer a variety of useful data in the area of visual collision avoidance. Author

N72-13083*# Battelle Memorial Inst., Richland, Wash. Pacific Northwest Labs.
THE MEASUREMENT OF RADIATION EXPOSURE OF ASTRONAUTS BY RADIOCHEMICAL TECHNIQUES Quarterly Research Report, 5 Oct. 1970 - 3 Jan. 1971
R. L. Brodzinski 15 Jan. 1971 39 p refs Sponsored by NASA
(NASA-CR-124838; BNWL-1183-7) Avail: NTIS CSCL 06R
Gamma analyses of the neutron-activated fecal samples from the Apollo 12 and 13 missions were completed, and the data are being evaluated. Samples of the exposed Apollo 12 solar wind composition foil and blank foils were obtained for analysis of the Po-2/0 (Pb-210, Rn-222) content. It is expected that the determination of the Po-210 content of these foils will yield the concentration of radon atoms incident on the foil while exposed to the lunar atmosphere, and this indirectly will permit an estimate of the average uranium concentration of the lunar surface. Proposals to measure the cosmic-ray intensity and energy spectra inside and outside of late Apollo and Project Skylab spacecraft by exposing and subsequently analyzing pure metal foils, and to measure the elemental mass balance in Project Skylab astronauts by instrumental neutron activation analysis of the intake and excreta are summarized.
Author (NSA)

N72-13084# Glasgow Univ. (Scotland). Dept. of Aeronautics and Fluid Mechanics.
SIMULATION OF RENDEZVOUS OF A MAN IN DEEP SPACE M.S. Thesis
Daniel Pablo Mendez Mar. 1971 130 p refs Sponsored in part by ESRO
Avail: NTIS
The rendezvous in deep space with his mother ship of an isolated astronaut using a self-maneuvering booster unit is studied by means of analog and digital simulation to determine major influences. The analog computer was used to represent the mother ship and stellar background, providing insight into the maneuver and astronaut performance. The digital computer simulated human behavior in various circumstances. Obtaining an optimum value for booster thrust which minimizes fuel consumption was of great importance. ESRO

N72-13085# Ohio State Univ., Columbus. Dept. of Electrical Engineering.
IMPROVED TECHNIQUES FOR THE CONTROL OF REMOTE DEVICES Final Scientific Report
Robert B. McGhee 10 Mar. 1971 7 p refs
(Grant AF-AFOSR-1901-70; AF Proj. 9769)
(AD-728214; AFOSR-71-2175TR) Avail: NTIS CSCL 06/2
Two major aspects of remote device control were investigated: locomotion and visual sensing. The remote device locomotion studies carried out under this grant have been aimed at the development of a theoretical understanding of the principles of legged vehicle design. It has long been recognized that the versatility of human beings in the extraction of relevant information from visual (optical) images far exceeds that of any machine. Yet, in particular circumstances, such as the reading of fixed font printed material, it has been possible to design special purpose processors with performance characteristics superior to those of humans. Recognizing this fact, the goal of this aspect of the present research program has been to attempt to devise automatic pictorial pattern recognition schemes comparable

effective to character recognizers, but capable of operating in a less well controlled environment. Author (GRA)

N72-13086# Army Aeromedical Research Lab., Fort Rucker, Ala.
CRASH INJURY ECONOMICS: THE COSTS OF TRAINING AND MAINTAINING AN ARMY AVIATOR
Armand E. Zilioli Apr. 1971 26 p refs
(DA Proj. 3A0-62110-A-819)
(AD-725482; USAARL-71-17) Avail: NTIS CSCL 05/9

While the hardware costs of Army aviation accidents are known, the monetary costs of injuries and fatalities have not been determined. In order to ascertain these costs, the training and maintenance costs of aviators are needed. The report presents a study of training and maintenance cost of Army aviators in all grade levels from training up to, including, and after an accidental death. Author (GRA)

N72-13087# Air Force Human Resources Lab., Brooks AFB, Tex.
SINGLE CONCEPT FILMS IN THE TRAINING OF FLIGHT SKILLS
Milton E. Wood Nov. 1970 44 p refs
(AF Proj. 1710)
(AD-728685; AFHRL-TR-70-34; Task-171003) Avail: NTIS CSCL 05/9

A study was conducted to determine the effectiveness of single-concept films in the training of T-37 landing maneuvers. Films study significantly reduced the amount of air time required to reach or exceed the levels of proficiency demonstrated by baseline students in normal landing practice. The study also provided insights into the production of in-flight films and their subsequent use as cartridge-loaded, single-concept film materials. Author (GRA)

N72-13088# Biomarine Industries, Inc., Devon, Pa.
A STUDY OF DIVER PERFORMANCE WITH COMMUNICATION AIDS, PHASE 2 Final Report, 30 Sep. 1970 - 30 Jun. 1971
Brendan P. Thompson and Irving R. Streimer 30 Jun. 1971 58 p refs
(Contract N00014-70-C-0162; NR Proj. 197-008)
(AD-726225; UWCP-70-15) Avail: NTIS CSCL 05/9

The performance of two divers working at 33 ft. on a communication dependent task was observed and measured. Comparisons between productivity and error generation using closed and open cycle breathing apparatus, as well as helium/oxygen, nitrogen/oxygen and argon/oxygen mixtures, were made. Measurement of oxygen uptake and carbon dioxide production during the communication task, as well as for a series of constant swim rates, was recorded. No significant difference in productivity was noted for any gas mixture or breathing apparatus used. Significant differences were noted in error generation for the helium/oxygen mixture. In addition, the distribution of errors between specific letter-number pairs and sound groups differed significantly for helium/oxygen mixtures. Oxygen uptake during the communication task was equivalent to that previously measured for self-paced work. Author (GRA)

N72-13089# System Development Corp., Santa Monica, Calif.
PROBLEM SOLVING AND LEARNING BY MAN-MACHINE TEAMS Final Technical Summary Report, Dec. 1964 - Nov. 1970
Aiko M. Hormann, Sharon Kaufman-Diamond (Calif. Univ., Los Angeles), and Carlos Martin Cinto (Calif. Univ., Los Angeles) Jul. 1971 262 p refs
(Contracts N00014-70-C-0221; DAHC15-67-C-0149)
(AD-729070; SDC-TM-4771/000/00) Avail: NTIS CSCL 06/4

The report describes research work in artificual intelligence, human and machine-aided problem solving and planning activities, interactive languages and visual input/output techniques, and man-machine synergy. Author (GRA)

N72-13090# Illinois Univ., Urbana. Aviation Research Lab.
ANNOTATED BIBLIOGRAPHY ON RESPONSE SURFACE METHODOLOGY AND RELATED PAPERS Interim Report
Charles W. Simon Apr. 1971 13 p refs Prepared by Hughes Aircraft Co., Culver City, Calif. Aerospace Group
(Contract F44620-70-C-0105; AF Proj. 9778)
(AD-729192; AFOSR-71-1941TR;
HAC-Ref-71-27-3945/C1183; Task-61102F) Avail: NTIS CSCL 12/1

The annotated bibliography provides basic references to multivariate analysis by use of response surface methodology. The references cited are being used in the preparation of documents on the application of Response Surface Methodology to human factors engineering research. Author (GRA)

N72-13091# Air Force Human Resources Lab., Brooks AFB, Tex.
ASSESSMENT OF TWO METHODS OF SEQUENCING GROUND TRAINER PRACTICE FOR UNDERGRADUATE PILOT TRAINING
Gary B. Reid, William V. Hagin, and David H. Coats Dec. 1970 17 p refs
(AF Proj. 1123)
(AD-728687; AFHRL-TR-70-40; Task-112302) Avail: NTIS CSCL 05/9

The study was an operational evaluation of two methods of instruction sequencing for the T-38 phase of Undergraduate Pilot Training. Scheduling of concentrated trainer phases prior to aircraft flight improved student performance for early aircraft rides as compared with an intermixed trainer and aircraft schedule. Although grade differences washed out prior to graduation, the students who trained under the block schedule completed training in 38 fewer aircraft flights than the students who trained under the intermixed schedule. Author (GRA)

N72-13092# TRW Systems Group, Redondo Beach, Calif.
DIVER INSTRUMENTATION Final Report
1 Aug. 1971 18 p refs
(Contract N00014-70-C-0310; NR Proj. 101-821)
(AD-728065; TRW-16416.002) Avail: NTIS CSCL 06/11

The diver instrumentation program was initiated for the purpose of conducting a study leading to the development of small, lightweight instruments to be used to monitor physiological parameters of divers. Tasks were defined as follows: Design, fabricate and test sensors to monitor respiratory heat loss; Design, fabricate and test a multipurpose diver instrument pack containing power supply, tape recorder, signal conditioners and pressure sensor; Package for evaluation a sensor for measuring the partial pressure of oxygen in a diver's breathing apparatus. GRA

N72-13093# Bolt, Beranek, and Newman, Inc., Cambridge, Mass.
HUMAN INFORMATION PROCESSING AND REACTION TIME
Richard W. Pew 10 Mar. 1971 14 p refs
(Contract F44620-69-C-0115; AF Proj. 9778)
(AD-728217; BBN-2111; AFOSR-71-2193TR) Avail: NTIS CSCL 05/10

The report was prepared to summarize for an engineering-oriented audience some of the basic principles underlying the determination of the time for human information processing. Author (GRA)

N72-13094# Aerospace Medical Research Labs., Wright-Patterson AFB, Ohio.
VISUAL RECONNAISSANCE FROM THE NOSE VERSUS SIDE SCANNER STATIONS OF AN AIRCRAFT Final Report
James L. Porterfield, Steve A. Heckart, Herschel C. Self, E. P. Hanavan, and Don F. McKechnie May 1971 20 p refs

(AF Proj. 7184)
(AD-729226; AMRL-TR-71-21; Task-718404) Avail: NTIS CSCL 05/5

The study investigated airborne visual reconnaissance from the nose versus side scanner stations of an aircraft. Six subjects performed the search task at the nose station of a B-50 aircraft and six different subjects performed the task at the two side scanner stations, located aft of the wings. During each pass one subject at the nose station and one at each of the scanner stations searched for tactical target sites located in rolling farm and woodland, and identified and counted the individual targets at the sites that they located. A mean of 65 percent of the target sites was detected by the subjects in the two scanner stations, whereas only 36 percent were detected by the subjects in the nose station. On the other hand, for the target sites that were detected, the scanner subjects identified only 37 percent of the individual targets while the subjects in the nose identified 60 percent. Wide differences between subjects were found in their search and identification performance. Author (GRA)

N72-13095# Army Test and Evaluation Command, Aberdeen Proving Ground, Md.
HUMAN FACTORS Final Report
1 Jul. 1971 63 p
(AMCR Proj. 310-6)
(AD-728824; MTP-6-3-525) Avail: NTIS CSCL 05/5

The procedure provides general guidance and extensive checklists of human factors considerations in evaluating electronic equipment. Author (GRA)

N72-13010*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
THE PILOT-AIRCRAFT INTERFACE
George E. Cooper *In its* Vehicle Technol. for Civil Aviation 1971 p 271-286 refs (See N72-12995 04-02)
Avail: NTIS HC $6.00/MF $0.95 CSCL 05E

N72-13960# Royal Swedish Academy of Engineering Sciences, Stockholm.
ENVIRONMENTAL PROBLEMS
In its Develop. in Res. and Technol. during 1970 1970 p 193-203 refs In SWEDISH (See N72-13942 04-34)
Avail: NTIS; Almqvist & Wiksell, Stockholm: 25 Kr

06 CHEMISTRY

Includes chemical analysis and identification (e.g., spectroscopy). For applications see: 17 Materials, Metallic; 18 Materials, Nonmetallic; and 27 Propellants.

N72-13096 National Lending Library for Science and Technology, Boston Spa (England).
CHEMILUMINESCENT DETERMINATION OF COBALT IN ZINC OF HIGH PURITY
A. K. Babko and N. M. Lukovskaya 1 Jun. 1971 6 p refs Transl. into ENGLISH from Anal. Khim. (USSR), v. 30, 1964 p 388-390
(NLL-NSTIC-Trans-2181-(6180-59)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

A technique has been developed for the determination of 0.000001 to 10 to the minus 7th power per cent bf cobalt in zinc of high purity. Analytical concentrates were obtained from 1 gr zinc thrbugh precipitation of the cobalt by alpha-nitroso-beta-naphthol. After suitable treatment of the concentrates, the cobalt was determined by photographic chemiluminescent method. The determination of 3 x 0.0001 per cent or more of cobalt in zinc sulphate was carried out without separation of the zinc. Author

N72-13097 National Lending Library for Science and Technology, Boston Spa (England).
CURRENT CARRIER MOBILITY AND CONCENTRATION IN POLYMERS WITH CONJUGATED DOUBLE BONDS
A. F. Lunin, V. G. Chernykh, S. S. Ogavesov, S. G. Moiseev, V. G. Kostrovskii, and Ya. M. Paushkin [1971] 10 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 197, no. 6, 1971 p 1366-1368
(NLL-M-20943-(5828.4F); UDC-621.315.59) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

Measurements of thermoelectric emf in polymers were made, and drift mobility and current carrier concentration were studied. Investigation showed that the thermoelectric emf of low ohmic specimens attains values of the order of 150 microvolts/deg C. That of high ohmic specimens may be as high as 600 microvolts/deg C. The thermoelectric emf was found to be slightly temperature dependent, giving grounds for assuming that the carrier concentration in the polymers studied is temperature-invariant. It may also be assumed that the activation relationship between conductivity and temperature is determined by the mobility of the current carriers. K.P.D.

N72-13098# Soviet Radio, Moscow (USSR).
SYNTHESIS OF SYSTEMS FOR THRESHOLD ELEMENTS
Ye. N. Vavilov, B. M. Yegorob, V. S. Lantsev, and V. G. Totsenko 1970 369 p refs In RUSSIAN
Avail: NTIS HC $6.00/MF $0.95

Conditions for realizing switching functions for a single threshold element are considered. Methods of synthesizing logic circuits and automata for threshold elements are investigated. A variety of threshold elements are described. A series of typical junctions and circuits for discrete action were studied. A table of threshold elements in six variables is presented. The synthesis methods lead to algorithms which can be conveniently applied to engineering practice. These are illustrated by example.
Transl. by K.P.D.

N72-13099*# Colorado State Univ., Fort Collins. Dept. of Chemistry.
ELECTROCHEMICAL STUDIES IN ALUMINUM CHLORIDE MELTS Final Status Report, 15 Aug. 1969 - 14 Aug. 1971
R. A. Osteryoung Aug. 1971 101 p refs
(Grant NGR-06-002-088)
(NASA-CR-124723) Avail: NTIS CSCL 07D

A melt purification system was developed which produces a final melt far superior electrochemically than those previously reported. A residual current of less than 2 microamps/sq mn at a sweep rate of 0.5 V/sec was used as the criteria for a pure melt. The use of a second purified bulk melt and a heated pipette permitted the rapid exchange of working electrode compartments while retaining the same reference electrode system. The major portion of the work was carried out in the 1:1 AlCl3:NaCl melt at 175 and 200 C. Several measurements were made in the 2:1 melt and a few on the silver systems in intermediate compositions. Programs for PDP-8I and PDP-12 digital computers and the required electronic circuitry systems were developed to carry out various electrochemical measurements in the melt. A pair of 50 yard transmission lines were used to connect the computer to the experiment. Ensemble averaging and digital, least squares smoothing are used within the programs to improve the signal-to-noise ratio by at least an order of magnitude. Some of the computerized electrochemcial techniques used to examine the different systems were pulse polarography, double pulse polarography, staircase voltammetry, kinetic double potential step chronoamperometry and double potential step chronocoulometry. Author

N72-13100# Connecticut Univ., Storrs. Dept. of Metallurgy.
THE EFFECT OF SODIUM OXIDE ON THE THERMAL OXIDATION OF SILICON
Owen F. Devereaux, Rong Yau Wang, and Kuang-Ho Chien Apr. 1971 28 p refs
(Contract F44620-69-C-0011; AF Proj. 7921)

(AD-728713; UC-Met-2-71; AFOSR-71-1077TR) Avail: NTIS CSCL 07/4

Polycrystalline silicon wafers coated with Na2CO3 were oxidized in ambient air with P(H2O) = 24 mm in the temperature range 702 to 1052C. Initial oxidation followed cubic kinetics due to the linear change in composition of the oxide film with oxidation. At longer times the oxidation became parabolic as the concentration of and, therefore, diffusivity of hydroxyl in the oxide became nonlinear with the sodium concentration in the film. This occurs at lower concentration of sodium, where the presence of sodium is manifested in the formation of hydroxyl by an autocatalytic reaction. Untreated specimens oxidized as controls during these experiments showed similar behavior due to vapor phase transport of Na2O. Author (GRA)

N72-13101*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

ANALYSIS OF HYDROGEN-DEUTERIUM MIXTURES Patent Application

Harry C. Lord, III, inventor (to NASA) Filed 6 Nov. 1970 12 p
(Contract NAS7-100)
(NASA-Case-NPO-11322; US-Patent-Appl-SN-87550) Avail: NTIS CSCL 07B

The ratio bf hydrogen to deuterium in a gas mixture is determined by separating and detecting the hydrogen component of the mixture, subjecting the component to ionizing radiation to form HD(+) ions and determining the concentration of HD(+) by high resolution infrared detector. The hydrogen isotopes are separated by passing the sample from a nozzle through a heated palladium film. NASA

N72-13102*# Radio Corp. of America, New York.

METHOD FOR DISTILLATION OF LIQUIDS Patent Application

Algerd Basiulis and Pauk K. Shefsiek, inventors (to NASA) Filed 14 Dec. 1970 16 p
(Contract NASw-1254)
(NASA-Case-XNP-08124-2; US-Patent-Appl-SN-97829) Avail: NTIS CSCL 07D

A method and apparatus for the distillation of materials are described. The material, which may include liquid metals, is to be disposed in the base of a U-shaped tube. The upstream leg is surrounded with cooling coils for condensation and the downstream leg has heating coils along a portion of it for vaporization. The bottom reservoir portion of the U is heated. Between the reservoir portion and the upstream leg of the U, and within the device, is a capillary tube to carry the heated material from the reservoir to the heated region. A series of these tubes can be connected together in continuous fashion to produce fractional distillation. NASA

N72-13103*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

ELECTROCHEMICAL BEHAVIOR OF THE BORON ANODE IN AQUEOUS SOLUTIONS

Betty S. DelDuca Washington Jan. 1972 17 p refs
(NASA-TN-D-6589; E-6202) Avail: NTIS CSCL 07D

The electrochemical oxidation of p-type boron in 0.2 N NaNO3 solutions of pH 0.4 to 13.1 was studied by galvanostatic techniques. The capacitance of the electrode, Tafel slopes, and a limited analysis of reaction mechanisms are reported. The anodic dissolution in acid solution is a charge-transfer-limited one-electron reaction to form a monovalent species in the over-potential region of 0.25 to 0.70 V. The dissolution in basic solution is most probably a one-electron charge-transfer reaction from a monovalent to divalent species involving three hydroxyl ions. Open circuit potentials were mixed potentials, probably due to hydrogen formation at open circuit but not contributing to the electrochemical reaction at the applied overpotential. Exchange current, estimated by extrapolation of the Tafel line to the standard oxidation potential for the boron reaction, were of the order of 10 to the minus 6th power A/cm2 in acid solution and 10 to the minus 12th power A/cm2 in basic solution. The reaction order of the rate determining acidic and basic reactions was determined with regard to (H+) and (OH-). The level of illumination had no effect on the electrochemical behavior of the electrode. Author

N72-13104# Bureau of Mines, Minneapolis, Minn. Metallurgy Research Center.

IONIC CONSTITUENTS OF dc DISCHARGES IN A He-SO2 MIXTURE

David G. Kuehnm and L. M. Chanin 1971 20 p refs
(BM-RI-7590; TN23.u7-no-7590; Dewey-7590; LC-622.06173) Avail: NTIS

Positive ion sampling studies have been conducted on dc discharges containing 0.33 percent sulfur dioxide in helium. Measurements were made for normalized gas pressure from 0.45 to 6.8 torr and discharge currents from 5 to 40 ma. Ion species observed included SO(+), S(+), SO2(+), SO3(+), O(+), and O2(+). Studies were conducted on the functional dependence of the various ion species with respect to axial distance, pressure, current, and gas flow rate. Interpretation of these results is consistent with the assumption of SO2 dissociation. Deposition of sulfur compounds was observed in the plasma container during these studies. The present results are compared with previous studies which have been conducted in SO2.
Author

N72-13105*# Scientific Translation Service, Santa Barbara, Calif.

THERMAL ACTIVATION ENERGY AND THE PROBLEM OF THE EMISSION MECHANISM DURING EXOELECTRON EMISSION FROM NaCl, PART 3

R. Seidl Washington NASA Dec. 1971 16 p refs Transl. into ENGLISH from Czech. J. Phys. (Czechoslovakia), v. 20, 1970 p 73-83
(Contract NASw-2035)
(NASA-TT-F-14088) Avail: NTIS CSCL 07D

The activation energy of thermal destruction of F-centers in NaCl was measured by means of optical absorption. The resulting value of 2.1 eV is in good agreement with our results obtained by means bf electron emission and luminescence. The different possibilities of interpreting the origin of this energy are discussed. It was pointed out that there are now more arguments for its interpretation as the thermal dissociation energy of F-centers than for any other interpretation. This interpretation leads to good agreement with the theoretical results of Pekar. The limited validity of the Rose relation is pointed out. Author

N72-13106# Institut fuer Chemie der Treibstoffe, Berghausen (West Germany).

PHASE STABILIZATION OF AMMONIUM NITRATES: INVESTIGATIONS OF COBALT AMMINE COMPOUNDS INFLUENCE ON STABILIZATION [DIE PHASENSTABILISIERUNG VON AMMONIMNITRAT UNTERSUCHUNGEN UEBER DIE BEEINFLUSSUNG DER STABILISIERUNG DURCH AMMINKOMPLEXE DES KOBALTS]

W. Engel 20 Dec. 1970 42 p refs In GERMAN
(ICT-13/70) Avail: NTIS

The manufacture of ammide compounds by melting ammonium nitrates with various bonds was successful only with manganese and cobalt. Investigations, using differential thermal analysis, X-ray diffraction and diletometry, showed that the phase stability of ammonium nitrate was not noticeably influenced by the addition of ammide compounds with diatomic cobalt. The compounds provided a drying effect so that the samples behaved, at low humidity, like completely dry ammonium nitrates and were changed from modification 4 into modification 2. Melting with hexammine-cobalt (III) nitrate did not improve the properties of the nitrates. The results indicate a slight improvement in modification 3. ESRO

N72-13107# Max-Planck-Institut fur Physik und Astrophysik, Munich (West Germany).
REACTIVE SCATTERING OF A SUPERSONIC 02-BEAM ON Ba ATOMS
Cristiano Batalli Cosmovici and Karl Wolfgang Michel 1971 15 p refs Sponsored in part by ESRO Submitted for publication
Avail: NTIS

Reactive scattering of a supersonic molecular oxygen nozzle beam to form barium oxide was detected by a rotatable quadrupole mass spectrometer. This indicates that the reaction is close to the rebound type, having an activation energy less than 0.1 eV. In addition not only the energy of the exothermic reaction (0.66 eV), but also a great deal of the initial relative kinetic energy (from 0.1 to 1.0 eV), appears in internal energy of the products. Author (ESRO)

N72-13108# Rocket Propulsion Establishment, Westcott (England).
COMPETITIVE REACTION KINETICS IN SEEDED FLAMES AND ROCKET EXHAUSTS
D. E. Jensen Feb. 1971 18 p refs
(RPE-TR-71/2) Avail: NTIS

In such nonequilibrium combustion systems as rocket exhaust plumes, reactions of the type X + HY reversibly yields XY + H and X + Y + M reversibly yields XY + M, where X is a metal atom or free electron, Y is a free radical and M is a collision partner, compete to determine concentration ratios (XY)/(X). Competition criteria suggested by Sugden are modified, extended, and exemplified by reference to particular reactions of practical interest. The criteria help the chemist to select the minimum number of chemical reactions for computer calculations on the properties of combustion systems. Recommended rate coefficients and uncertainties are offered for several reactions of the above types. Author (ESRO)

N72-13109# Aerospace Research Labs., Wright-Patterson AFB, Ohio. Chemistry Research Lab.
THE SHOCK TUBE ISOMERIZATION OF CYCLOPROPANE WITH INFRARED ANALYSIS Interim Scientific Report
Ernest A. Dorko, Ulrich Grimm, Gerhard Mueller, and Karl Scheller May 1971 35 p refs
(AF Proj. 7023011)
(AD-728638; ARL-71-0089) Avail: NTIS CSCL 07/4

In a continuing effort to develop kinetic analyses in shock tubes, the isomerization of cyclopropane to propylene was investigated. Three aspects of the problem were investigated: the theoretical analysis, the experimental infrared method of analysis, and the mathematical analysis. The test gas mixtures ranged from 0.1 to 5% cyclopropane in Argon. The temperature range was 1000 - 1350K. Kinetic measurements were made by means of infrared emission measurements at 4.79 microfs. This band corresponds to the V5+V10 combination band in the IR absorption spectrum of cyclopropane. A plot of the logarithm of the intensity of emission versus time was prepared. It was discovered that the rate constants determined show a dependence on the cyclopropane concentration although they are independent bf total or argon concentration. A discussion is given which indicates that the conventional steady-state assumption may not be valid for reactions in a shock tube. Author (GRA)

N72-13110# Army Foreign Science and Technology Center, Charlottesville, Va.
RADIATION OF OXIDIZABILITY OF OILS AND OILS WITH ADDITIVES BY A METHOD OF CHEMILUMINESCENCE
A. M. Kuliev, G. G. Gurylev, V. B. Liksha, and L. G. Suleimanova 30 Jun. 1971 13 p ref Transl. into ENGLISH from Izluchenie Okislyaemosti Masel s Prisadkami Metodom Khemilyuminestsents-ii, Academy of Sciences of the Azerbaidzhan SSR
(AD-728151; FSTC-HT-23-985-71) Avail: NTIS CSCL 11/8

Research on the oxidizability of oils and oils with additives was studied by a method of chemiluminescence. The effectiveness of additives, the work capacity of oil with various additives, depending on time and temperature were tested. The chemiluminescent method is preferable to other methods because of: the speed of tests; the stable data obtained; and the small quantity of the product required for testing. Author (GRA)

N72-13111# Army Foreign Science and Technology Center, Charlottesville, Va.
ON THE CARBONIZATION OF PHENOL-FORMALDEHYDE RESINS IN THE PRESENCE OF POLYMERS WITH A LINKING SYSTEM
R. M. Aseeva and A. A. Berlin 15 Jul. 1971 9 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR, Ser. Khim. (USSR), no. 12, 1969 p 2835-2837
(AD-728147; FSTC-HT-23-718-71) Avail: NTIS CSCL 11/9

The influence of certain cross-linked polymers on carbonization of resins was studied at 200-1000C. The product of thermolysis of anthracene was found to improve the structure of the reaction product. Author (GRA)

N72-13112# Bell and Howell Research Center, Pasadena, Calif. Electronic Materials Div.
ANALYTICAL TECHNIQUES FOR THE DETERMINATION OF TRACE IMPURITIES IN II-VI COMPOUNDS Final Report, 1 Jun. 1968 - 31 May 1970
Arthur J. Socha, Eleanor M. Masumoto, and Robert K. Willardson Wright-Patterson AFB, Ohio ARL Sep. 1970 96 p refs Supersedes AD-717706
(Contract F33615-68-C-1635; AF Proj. 7885)
(AD-728219; AD-717706; ARL-70-0170) Avail: NTIS CSCL 07/2

Analyses of II-VI compounds were performed using spark source mass spectrometer techniques. Of a total of 193 samples, 153 were analyzed using photographic techniques and 40 using electronic methods. The compounds of primary interest were CdS, CdSe, ZnS, and ZnSe. Detection limits were on the order of 1 to 10 parts per million. A technique was developed for determining oxygen in cadmium sulfide. Oxygen was found in concentrations of a few parts per million. Studies were made involving platinum as a probe material. The effects of using 24 kV accelerating voltage as compared with 16 kV were also investigated. A new technique was developed for the analysis of sulfur. Detection limits of +0.1 parts per million were obtained. A new type of mass spectrometer was used for the first time to investigate the distribution of impurities in cadmium sulfide. The instrument, called the Ion Microanalyzer has the capability of analyzing surfaces by sputtering away successive monolayers of material with a beam of ionized gas. Ion images, and mass spectra were obtained for samples of sodium- and copper-doped cadmium sulfide. Author (GRA)

N72-13113# Naval Postgraduate School, Monterey, Calif.
PHOTOCHEMISTRY OF NITRAMINES. 2: STOICHIOMETRY, INTERMEDIATES AND PRODUCTS M.S. Thesis
Harry Whittaker Jun. 1971 85 p refs
(AD-728721) Avail: NTIS CSCL 07/5

The investigation was concerned with the photochemical decomposition of nitramines, particularly N-nitropyrrolidine and N, N-dinitropiperazine. Photolyses were carried out in solution and in the solid state. Intermediates were identified by spectroscopic studies and by synthesis. On the basis of the intermediates, products, and spectroscopy of products, a mechanism for the photochemical decomposition of N-nitropyrrolidine was postulated. Author (GRA)

N72-13114# Picatinny Arsenal, Dover, N.J.
ELECTRIFICATION IN FLOW OF ALCOHOL-FREON MIXTURES THROUGH SOLID FILTER BEDS
Maurice S. Kirshenbaum and Richard R. Fyfe Jun. 1971 72 p refs
(AD-728807; PA-TR-4193) Avail: NTIS CSCL 07/1

The report presents results of laboratory experiments simulating the washing and filtration operations in a typical

metastable materials process line with regard to generation, transport, and relaxation of electrostatic charge. The metastable material filter bed was simulated by a precisely characterizable filter disk. Wash fluids used were Freon and its admixtures with methanol and ethanol. Streaming current, potential rise rate, and relaxation half-times were determined for each admixture system, varying the alcohol content in a given mixture from 0 to 100 volume percent. Results indicate that behavior with regard to electrostatic charge is a definite function of the volume percent alcohol in Freon-alcohol mixtures used as a wash fluid for the inert simulated filter beds studied. Also, the electrostatic charge behavior was significantly different in Freon-methanol-inert filter systems than in Freon-ethanol-inert ones. Based on the experimental results, a scheme is presented to the engineer for assessment of danger zones with respect to electrostatic hazards in a given process design. Author (GRA)

N72-13115# Picatinny Arsenal, Dover, N.J. Propellants Lab.
STUDY OF SYNTHESIS OF N-NITROBORAZINE COMPOUNDS. 1: NITRYL CHLORIDE AS NITRATING AGENT
T. Hirata Jun. 1971 17 p refs
(DA Proj. 1T0-61101-A-91)
(AD-728806; PA-TM-2010) Avail: NTIS CSCL 07/2

While assessing nitryl chloride (NO2Cl) as a possible nitrating agent for borazine and its derivatives, an analysis of several infrared spectra indicated that samples of nitryl chloride were contaminated with nitrosyl chloride (NOCl). Considerable attention was focused on the source of nitrosyl chloride and on means for its removal. A purification procedure was ultimately developed consisting of the simultaneous precipitation of NOCl and dinitrogen tetroxide (N2O4) as the solid complexes of boron trifluoride (BF3). Nearly water-white nitryl chloride was obtained in this manner. A tinge of yellow was attributed to the presence of chlorine. The reaction of nitryl chloride with a model compound, lithium dimethylamide, was found to yield dimethylnitramine as one of the reaction products. This is in contrast to previous studies made on the gas phase reactions of nitryl chloride with ammonia and several amines. A discussion is presented in view of these contrasting results. Author (GRA)

N72-13116# Nottingham Univ. (England). Dept. of Inorganic Chemistry.
FLOW DECAY Annual Scientific Report, 1 Jul. 1970 - 30 Jun. 1971
C. C. Addison 30 Jun. 1971 70 p refs
(Contract F61052-70-C-0035; AF Proj. 3148)
(AD-728731; AFRPL-TR-71-104; Rept-62302F) Avail: NTIS CSCL 07/2

The compound Fe(NO3)3.N2O4 (NO(+)Fe(NO3)4(-)) was previously identified as the principal constituent of deposits responsible for flow-decay of liquid propellant N2O4 in steel systems. In the light of this, an extensive investigation of N2O4 adducts of Fe(NO3)3 has been carried out including synthesis, analysis, vibrational spectroscopy and X-ray studies. The work indicates that the constituent species of the solid adducts Fe(NO3)3(x)N2O4 (where x is typically 1.0-1.5) are NO(+), NO(+) (solvated by NO2 or N2O4), Fe(NO3)4(-), and N2O4. The behaviour of these adducts has also been studied in HNO3 solution and in HNO3/N2O4 mixtures. The properties of the Fe(NO3)3(x)N2O4/HNO3/N2O4 system are interpreted in terms of a gross modification of the HNO3/N2O4 phase diagram by Fe(NO3)3(x)N2O4. A flow apparatus has been constructed so that flow-decay deposit may be collected and its chemical identity and physical form studied as a function of the water (HNO3) content of N2O4 (monitored by H n.m.r.). A number of projected investigations is also discussed. Author (GRA)

N72-13117# Army Foreign Science and Technology Center, Charlottesville, Va.
HIGHLY DISPERSED AEROSOLS
N. A. Fuks and A. G. Sutugin 22 Jun. 1971 91 p refs Transl. into ENGLISH from the book "Fizicheskaya Khimiya" Moscow, 1969 p 5-83
(AD-728736; FSTC-HT-23-225-71; T702301-2301) Avail: NTIS CSCL 07/4

An examination is made of the processes of formation of highly dispersed aerosols with particle dimensions less than 0.1 micron, methods of generation and investigations of these aerosols and their physical properties, which differ radically from the properties of coarsely dispersed aerosols. Despite the tremendous importance of highly dispersed aerosols in meteorology and several other branches of science, despite the enormously important role that they play in the processes of formation of condensation aerosols in nature and in science, there is practically no review-monographic literature on this subject and the review is an attempt to bridge this gap. Author (GRA)

N72-13118# Quantum Systems, Inc., Albuquerque, N. Mex.
CALCULATIONS OF ELECTRON IMPACT CROSS SECTIONS Final Report, 1 Jun. 1970 - 31 May 1971
Stephan Ormonde and Barbara W. Torres May 1971 57 p refs
(Contract F44620-70-C-0102; AF Proj. 9751-01)
(AD-728684; AFOSR-71-2222TR; Rept-61102F; Rept-681302) Avail: NTIS CSCL 07/4

The report is concerned with calculations of atomic collision processes with the generalized multiconfiguration, multichannel electron-atom scattering code. Results are presented for the scattering of low energy electrons by nitrogen(+) and oxygen(++) and comparison made with the only other configuration interaction model developed to date. Collision of strengths for transitions out of the ground state configuration of ions of nitrogen and oxygen are given. Author (GRA)

N72-13119# Naval Postgraduate School, Monterey, Calif. Dept. of Physics.
THE EFFECT OF EVAPORATED METALLIC ELECTRODES ON THE TRANSITION TEMPERATURE OF TRI-GLYCINE SULPHATE M.S. Thesis
Richard Fairfax Pell Jun. 1971 46 p refs
(AD-728572) Avail: NTIS CSCL 20/3

Measurements of the effect of electrode thickness on the transition temperature of tri-glycine sulphate (TGS) are reported. An increase in the transition temperature is predicted utilizing the elastic Gibb's free energy equation of state. The prediction is verified by capacitance versus temperature measurements for evaporated gold electrodes varying in thickness from 250A to 3000A. The predicted increase in transition temperature is 0.15C while the measured value is 0.07C. Author (GRA)

N72-13120# Naval Postgraduate School, Monterey, Calif.
ELECTRON PARAMAGNETIC RESONANCE INVESTIGATION OF IRRADIATED LITHIUM ACETATE DIHYDRATE AND MERCURIC ACETATE SINGLE CRYSTALS M.S. Thesis
Clinton James Coneway Jun. 1971 94 p refs
(AD-728570) Avail: NTIS CSCL 07/5

An electron paramagnetic resonance study of X-ray irradiated single crystals of lithium acetate dihydrate and mercuric acetate has been made. The CH2(.)CO2(-) radical has been identified in lithium acetate dihydrate irradiated at liquid nitrogen temperature. The HCH angle was found. The principle elements of the hyperfine tensor and the g tensor were calculated. Mercuric acetate irradiated at liquid nitrogen temperature showed the presence of two CO2(-) species. Spectra at -80C showed the presence of two CH2(.)CO2(-) radicals. The principal values of the hyperfine tensor for the two magnetically distinct sites were obtained. Author (GRA)

N72-13121# Detroit Univ., Mich. Dept. of Chemistry.
PLASMA PINCH FLASH PHOTOLYSIS Final Report
Gilbert J. Mains 1 Jul. 1971 68 p refs
(Grants AF-AFOSR-0980-67; AF-AFOSR-0980-66; AF Proj. 9760)

(AD-728218; AFOSR-71-2141TR) Avail: NTIS CSCL 07/5

The theta-pinch flash lamp has been investigated for applications to photochemical studies. Attempts to find evidence for two photon absorption processes in several systems, including solutions of perylene in ethanol, subjected to the intense light flux from the theta-pinch lamp were not successful. Similarly, a search for the absorption spectrum of the phenyl radical in the liquid phase transient photolysis products from the theta-pinch flash photolysis of mercury diphenyl failed. A study of the theta-pinch and conventional flash photolysis of biacetyl pointed up the need for control of the cooling of the theta-pinch lamp in photochemical investigations. The low intensity (2537A), flash intensity and theta-pinch intensity photolysis of silyl iodide has been carried out at room temperature in the presence of scavenger and/or moderating gases. Some evidence is available for the formation of 'hot' silyl radicals. This research represents the first comprehensive study of the photolysis of silyl iodide.

Author (GRA)

N72-13122# Fulmer Research Inst., Ltd., Stoke Poges (England).

THE TRANSPORT OF BERYLLIUM IN BERYLLIUM DICHLORIDE VAPOUR

P. Gross and R. H. Lewin 23 Jul. 1971 25 p refs

(Contract F61052-70-C-0021; AF Proj. 9713-02)

(AD-728679; R.163/SR.8; AFOSR-71-2239TR; Rept-61102F; Rept-681308) Avail: NTIS CSCL 07/4

Experiments on the transfer of beryllium in beryllium chloride at pressures of about 0.00014 atmospheres have been made in the temperature range between 1250 and 1500K. The transport can be well interpreted as resulting from the reaction Be(solid) + BeCl2(g). The interpretation, however, cannot be reconciled with the mass spectroscopic investigation by Hildenbrand and Theard on the enthalpy of formation of monomer beryllium monochloride gas. With a reasonably estimated value for the entropy of the molecule (BeCl)2 the transport can be interpreted as resulting from Be(s) + BeCl2(g) = (BeCl)2(g) but this leads to a heat of association of monomer monochloride to the dimer which is very high, of the order of -90 kcal. Author (GRA)

N72-13123# Fulmer Research Inst., Ltd., Stoke Poges (England).

HEAT OF FORMATION OF ALUMINUM BROMIDE

P. Gross, C. Hayman, and M. C. Stuart 23 Jul. 1971 13 p refs

(Contract F61052-70-C-0021; AF Proj. 9713)

(AD-728716; R.163/SR.9; AFOSR-71-2241TR; Rept-61102f; Rept-681307) Avail: NTIS CSCL 07/4

The standard heat of formation of crystalline aluminium tribromide at 25C has been measured calorimetrically by reacting aluminium with liquid bromine in a glass combustion vessel. Separate measurements were made of the heat of solution of aluminium tribromide in bromine. A small correction to the experimental heat was made to account for the evaporation of bromine into the originally evacuated part of the vessel using published data. It amounted to approximately 0.06 percent. The heat of solution of aluminium bromide in bromine was also found. Author (GRA)

N72-13124# Purdue Univ., Lafayette, Ind. Project Squid Headquarters.

RESPONSE OF UNSTABLE CHEMICAL SYSTEMS TO EXTERNAL PERTURBATIONS

Peter J. Ortoleva and John Ross Aug. 1971 12 p refs Prepared in cooperation with MIT, Cambridge

(Contract N00014-67-A-0226-0005; NR Proj. 098-038; Squid Proj.)

(AD-728756; SQUID-TR-MIT-60-PU) Avail: NTIS CSCL 07/4

For a system of coupled chemical reactions, with diffusion and in a homogeneous steady state near marginal stability, the response to a periodic external perturbation is derived in a linear analysis and shown to be a resonance phenomena. Responses to perturbations of external variables with small effects on the rate coefficients are amplified at resonance. Suggested applications of the theory are: Study of kinetic parameters and their dependence on external variables; Use of marginally stable systems as analogues of electronic devices; Use of marginally stable systems as sensors and receptors; Out-of-phase external perturbations as stabilization methods; and Double resonance experiments. Author (GRA)

N72-13125# Purdue Univ., Lafayette, Ind. Jet Propulsion Center.

PENETRATION OF BOUNDARY PERTURBATIONS IN UNSTABLE CHEMICAL SYSTEMS

Peter J. Ortoleva (MIT, Cambridge) and John Ross (MIT, Cambridge) Aug. 1971 29 p refs

(Contract N00014-67-A-0226-0005; NR Proj. 098-038; Squid Proj.)

(AD-728755; SQUID-TR-MIT-59-PU) Avail: NTIS CSCL 07/4

The effects of boundary perturbations of chemical species is investigated in a linear analysis for systems of coupled chemical reactions, with diffusion, which have instabilities. At marginal stability of one of the harmonic modes of such a system the penetration depth of the chemical boundary perturbation coupled to that mode approaches infinity at resonance, that is at the frequency of boundary perturbation equal to the marginal oscillatory frequency of the mode. For the case of equal and diagonal diffusion coefficients for all chemical species the penetration of the perturbation is homogeneous at resonance; unattenuated inhomogeneous penetration occurs in association with symmetry breaking instabilities of the system. The propagation of an impulse boundary perturbation is derived. Some possible applications of the theory are suggested but not demonstrated: Analysis of chemical instabilities; analogies of electronic devices such as tuned amplifiers, transmitters and receivers (chemical radio); communication in aggregates of biological systems; and mechanism of pheromone emission and reception. Author (GRA)

N72-13126# Picatinny Arsenal, Dover, N.J.

STUDY ON SYNTHESIS OF N-NITROBORAZINE COMPOUNDS. 2: BORAZINE DERIVATIVES

T. Hirata Jun. 1971 19 p refs

(AD-729339; PA-TM-2011) Avail: NTIS CSCL 07/2

Attempts to synthesize borazine derivatives for use in propellants and related tems are described. Borazine itself was unsuitable as starting material since it has a tendency to polymerize and/or decompose at room temperature; however, B-trimethylborazine is extremely stable from decomposition or attack from air or moisture. Borazine reacted violently with nitryl chloride in the absence of diluent. In solution, the reaction was moderate but vigorous and the borazine appeared to have been completely oxidized. Synthesis and isolation of B-trimethylborazine from B-trichloroborazine and methyl lithium or methyl magnesium chloride proved to be extremely tedious. In addition the yields were much lower than expected. Conditions were varied but yields did not improve. The regeneration of borazine from its solid complex with hydrogen chloride was investigated in order to devise a convenient method for its storage. Author (GRA)

N72-13946# Royal Swedish Academy of Engineering Sciences, Stockholm.

THE UTILISATION OF THE ESCA METHOD

In its Develop. in Res. and Technol. during 1970 1970 p 59-63 refs In SWEDISH (See N72-13942 04-34)

Avail: NTIS; Almqvist & Wiksell, Stockholm: 25 Kr

07 COMMUNICATIONS

Includes communications equipment and techniques, noise; radio and communications blackout; modulation telemetry; tracking radar and optical observation; and wave propagation. For basic research see: 23 Physics, General; and 21 Navigation.

N72-13127 National Lending Library for Science and Technology, Boston Spa (England).

A NEW METHOD OF RADAR AREAL RAINFALL MEASUREMENTS

G. P. Berjulev, V. V. Kostarev, and A. A. Cernikov [1971] 10 p refs Transl. into ENGLISH from Cent. Aerol. Obs., T. Vyp. 100 (Moscow), 1970 p 115-124

(NLL-M-20762-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

Radar measurements of precipitation have the following advantages: the precipitation measurements and calibration procedures do not involve measurements of the absolute strengths of the reflected signals; calibration is simple and does not appreciably increase observation time; intensity and amount of precipitation over large areas can still be measured from a single point; and radar calibration and precipitation measurements can be made automatic with relatively simple equipment. Author

N72-13128 National Lending Library for Science and Technology, Boston Spa (England).

DETERMINATION OF VERTICAL VELOCITY IN RAIN BY DOPPLER RADAR

A. G. Gorelik and V. F. Logunov [1971] 10 p refs Transl. into ENGLISH from Tr. Tsentr. Aerolog. Observ. (Moscow), no. 98, 1970 p 102-112

(NLL-M-20895-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

A number of series of Doppler radar measurements on rain were processed on the basis of determined vertical velocities. The overwhelming majority of vertical velocities indicated that even rain of medium or high intensity vertical velocity does not exceed the errors inherent in the method. Only in 10% of the cases were vertical velocities of more than 2 m/s recorded. Author

N72-13129 British Broadcasting Corp., Kingswood (England). Research Dept.

PULSE CODE MODULATION OF VIDEO SIGNALS: SUBJECTIVE TESTS ON ACCEPTABLE LIMITS FOR TIMING JITTER IN THE DECODED ANALOGUE SAMPLES

V. G. Devereux 1971 6 p refs

(BBC-1971/42; EL-58; UDC-621.376.56-621.397) Avail: BBC, Kingswood Warren, Tadworth, Surrey, England

Tests were performed to investigate the subjective effect on a television display of timing jitter in the samples of a 625-line video signal obtained from a PCM digital to analog converter. The results of these tests were used to obtain limits for the amount of both random and sinusoidal forms of jitter which can be tolerated in a broadcast-quality television system. Author

N72-13130# Hamburg Univ. (West Germany). Inst. der Fraunhofer-Gesellschaft.

THE SIGNIFICANCE OF THE MARITIME EVAPORATION DUCT FOR RADAR-WAVE PROPAGATION WITHIN THE HORIZON

H. W. Fruechtenicht 1971 62 p refs In ENGLISH and GERMAN

(Rept-17) Avail: NTIS

A method is proposed for model calculations of microwave propagation over the sea within the horizon, which is based on ray tracing. The method is applied to a linear and a logarithmic profile of the modified refractive modulus. For the linear profile analytic expressions of A sub 1, A sub 2 and psi sub 1, psi sub 2 are given as well as a corresponding numerical method for the logarithmic distribution. Author

N72-13131*# Maryland Univ., College Park. Computer Science Center.

PERFORMANCE OF OPTIMUM DETECTOR STRUCTURES FOR NOISY INTERSYMBOL INTERFERENCE CHANNELS

J. D. Womer (Lehigh Univ.), B. D. Fritchman (Lehigh Univ.), and L. N. Kanal Jul. 1971 190 p refs

(Grants NGR-21-002-008; AF-AFOSR-1982-71)

(NASA-CR-124692; TR-164) Avail: NTIS CSCL 17B

The errors which arise in transmitting digital information by radio or wireline systems because of additive noise from successively transmitted signals interfering with one another are described. The probability of error and the performance of optimum detector structures are examined. A comparative study of the performance of certain detector structures and approximations to them, and the performance of a transversal equalizer are included. Author

N72-13132*# Washington Univ., St. Louis, Mo. Center for Development Technology.

FUTURE DEVELOPMENT OF INSTRUCTIONAL TELEVISION

Harold J. Barnett, Arthur T. Denzau, James R. DuMolin, and Jai P. Singh Nov. 1971 44 p refs

(Grant NGL-26-008-054)

(NASA-CR-124700; Memo-71-5) Avail: NTIS CSCL 17B

The use of television in schools as an aid to instruction is proposed for individualized instruction, repetition for slow learners, acceleration for fast learners, and lectures from the best teachers for all students. A dedicated school district cable system, a 40 channel cable to each school and classroom, is considered. This innovation offers an opportunity for improving the quality and content of the school's instruction and for reducing the cost. J.A.M.

N72-13133*# Washington Univ., St. Louis, Mo.

DESIGN OF A 12-GHz MULTICARRIER EARTH-TERMINAL FOR SATELLITE-CATV INTERCONNECTION

Burton A. Newman, Jai P. Singh, and Fred J. Rosenbaum Nov. 1971 68 p refs

(Grant NGL-26-008-054)

(NASA-CR-124699; Memo-71-8) Avail: NTIS CSCL 17B

The design and development of the front-end for a multi-carrier system that allows multiplex signal transmission from satellite-borne transponders is described. Detailed systems analyses provided down-converter specifications. The 12 GHz carrier down-converter uses waveguide, coaxial, and microstrip transmission line elements in its implementation. Mixing is accomplished in a single-ended coaxial mixer employing a field-replacable cartridge style diode. G.G.

N72-13134*# Washington Univ., St. Louis, Mo.

OPERATING FREQUENCIES FOR EDUCATIONAL SATELLITE SERVICES

Jai P. Singh Nov. 1971 69 p refs

(Grant NGL-26-008-054)

(NASA-CR-124725; Memo-71-10) Avail: NTIS CSCL 17B

The factors affecting the choice of transmission frequencies are identified. These include international radio regulations, natural environment, man-made environment, hardware considerations, and interconnection and spectrum space considerations. An analysis is presented of international radio regulations with emphasis on 1963 EARC and 1971 WARC frequency allocations, powerflux density restrictions, and resolutions concerning introduction of broadcasting-satellite systems. Natural-environmental effects were divided into two categories: (1) those due to transionospheric propagation, and (2) those that can be credited to the earth's atmosphere and its constituents. The frequency dependence of the signal attenuation, signal distortion, and contributions to system noise

temperature due to environmental effects are discussed, and comparisons were made for frequencies of interest. Man-made environmental effects were examined in terms of various sharing limitations as well as the indigenous noise contribution to the overall system noise. Author

N72-13135*# Washington Univ., St. Louis, Mo.
INSTRUCTIONAL TELEVISION UTILIZATION IN THE UNITED STATES
James R. DuMolin Oct. 1971 51 p refs
(Grant NGL-26-008-054)
(NASA-CR-124734; Memo-71-6) Avail: NTIS CSCL 17B

Various aspects of utilizing instructional television (ITV) are summarized and evaluated and basic guidelines for future utilization of television as an instructional medium in education are considered. The role of technology in education, capabilities and limitations of television as an instructional media system and the state of ITV research efforts are discussed. Examples of various ongoing ITV programs are given and summarized. The problems involved in the three stages of the ITV process (production, distribution, and classroom utilization) are presented. A summary analysis outlines probable trends in future utilization. Author

N72-13136# Technische Hochschule Hannover (West Germany).
A MEASURING METHOD FOR THE NUMERICAL ANALYSIS OF BROADBAND RADAR SIGNAL SYSTEMS ONBOARD SHIP Ph.D. Thesis
Lothar Krisch 1970 146 p refs In GERMAN
Avail: NTIS

A structural analysis of sea state echoes in navigational radar signals for their suppression is reported. It is shown that the intensity of the sea state echo depends on incidence angle, distance, radar frequency, radar signal polarization, heights of the sea waves, wind velocity and direction, as well as on Doppler shifts in radar frequency, echo duration, location, and correlation with the target element. Digital quantization of radar echo signals from a large area by digital computer provides a practical measurement system for the reconstruction of echo propagation and the structure of the sea state clutter. Transl. by G.G.

N72-13137# Soviet Radio, Moscow (USSR).
MULTICHANNEL ITERATION SYSTEMS FOR AUTOMATIC CONTROL
P. F. Osmolovskiy 1969 255 p refs In RUSSIAN
Avail: NTIS

The dynamics of multichannel iteration schemes are considered, in particular those used to increase the accuracy of producing useful signals in stationary and transitory systems during mixing. An iteratiofal construction principle is established, and an algorithm for the function of multichannel precision systems is presented. Recurrent relationships for operators of continuous and discrete systems permit the observation of their dynamic properties independent of various methods of realization. The influence of the number of channels and their parameters on the magnitude of dynamic and random errors in integration systems with and without the presence of noise are considered. Means of the self-adjustment of compensating channels during the measurements of static features acting internally are discussed. Transl. by K.P.D.

N72-13138# Queens Univ., Kingston (Ontario). Dept. of Electrical Engineering.
DESIGN OF OPTIMAL RADAR SIGNALS SUBJECT TO A FIXED AMPLITUDE CONSTRAINT
Mohammed Farooque Mesiya Aug. 1971 122 p refs
(RR-71-3) Avail: NTIS

The problem of designing finite-pulse-train radar signals and receivers to maximize the detectability of targets masked by thermal noise and clutter returns is considered. A practical constraint is introduced: the amplitude of each sub-pulse in the transmit waveform is taken to be fixed. This limits the transmitter waveform design to an optimal selection of only the phase modulation of the signal. The need for such a constraint arises because practical radar considerations dictate that the amplitude of the transmitter waveform should be a constant. A optimization problem incorporating the fixed amplitude constraint is formulated and a computer algorithm for generating optimal waveforms is presented. Examples of the application of the new algorithm to two radar signal design problems are given. A comparison of the performance with other signal design procedures, which impose either an energy constraint or a dynamic range constraint, is made. It is concluded that practical fixed amplitude waveforms can be designed to effectively combat the presence of clutter and thermal noise in radar systems. Author

N72-13139# Australian Post Office Research Labs., Melbourne.
A FIXED FREQUENCY SYNTHESISER: FFS-1
I. P. Macfarlane Oct. 1970 39 p refs
(Case-3078; Rept-6476) Avail: NTIS

A frequency synthesizer was developed to supply three transmitter excitor frequencies. The three frequencies are derived from a single 1-MHz input frequency from a frequency standard. Author

N72-13140*# International Business Machines Corp., Huntsville, Ala. Electronics Systems Center.
A GUIDE TO ONBOARD CHECKOUT. VOLUME 7: RF COMMUNICATIONS
Sep. 1971 64 p
(Contract NAS9-11189)
(NASA-CR-115256; IBM-71W-00314-Vol-7) Avail: NTIS CSCL 17B

The radio frequency communications subsystem for a space station is considered, with respect to onboard checkout requirements. The subsystem comprises all equipment necessary for transmitting and receiving, tracking and ranging, command, multiple voice and television information, and broadband experiment data. The communications subsystem provides a radio frequency interface between the space station and ground stations, either directly or indirectly, through a data relay satellite system, independent free-flying experiment modules, and logistics vehicles. Reliability, maintenance, and failure analyses are discussed, and computer programming techniques are presented. K.P.D.

N72-13141# Japan Broadcasting Corp., Tokyo.
COMPUTER DRAWING OF FIELD STRENGTH MAP
Shiro Ito, Yasuji Kurakake, Shinji Yamanouchi, and Masashi Nakamura Feb. 1971 12 p refs
(NHK-Labs-Note-140) Avail: NTIS

A computer method is described for drawing a field strength map to assist in predicting the effective service area of a broadcasting station or mobile radio network operating in the VHF and UHF bands. By using the rapid processing facility of a digital computer, a detailed terrain profile for every radio path in the area concerned was reproduced, and the field strength for the path was computed on the basis of propagation formulas. The contour map of the field strength was traced automatically. Author

N72-13142# Japan Broadcasting Corp., Tokyo. Technical Research Labs.
A MODIFIED COMPOSITE COLOR TELEVISION SIGNAL FOR NARROW-BAND TRANSMISSION
Takashi Fujio and Makoto Miyahara Sep. 1970 14 p refs
(NHK-Labs-Note-135) Avail: NTIS

The signal processing and characteristics of the modified signal, with chrominance multiplexed in a band lower than the standard color signal, was described. The modified signal transmission system represents an exchange of SNR improvement for vertical resolution of the picture having detail in the lateral direction. It is effective when the transmission band is limited or when large numbers of video signals must be transmitted in a

fixed bandwidth via satellite. Using this experimental equipment, modification, transmission and reconversion were carried out by adding a standard color television signal to the input. It was found that when video information can be encoded directly in the form of a modified signal, better picture quality transmission is possible. In this case, polarity of the chrominance signal should be selected correctly for modulating the 2.352273MHz so that the modulated signal will be converted to the standard color carrier signal. Author

N72-13143*# Comsat Corp., Clarksburg, Md.
ORTHOGONAL TRANSFORM FEASIBILITY STUDY
Guner S. Robinson Nov. 1971 176 p refs
(Contract NAS9-11240)
(NASA-CR-115314; CL-TR-5-71) Avail: NTIS CSCL 17B

The application of various orthogonal transformations to communication was investigated, with particular emphasis placed on speech and visual signal processing. The fundamentals of the one- and two-dimensional orthogonal transforms and their application to speech and visual signals are treated in detail. Author

N72-13144# Joint Publications Research Service, Washington, D.C.
BACKSCATTER IONOSPHERIC SOUNDING
Yu. A. Chernov 10 Jan. 1972 212 p refs Transl. into ENGLISH of the book "Vozvratnonaklonnoye Zondirovaniye Ionosfery" Moscow, Svyaz Press, 1971 204 p
(JPRS-54893; UDC-621.371) Avail: NTIS

The presented monograph is basically devoted to the theory of the method of backscatter sounding. In particular, the effects of magneto-ionic splitting in the ionosphere on the position of the scattered signal front, the energy losses during backscatter sounding and the factors on which they depend are emphasized. Also considered are the possibilities of backscatter sounding as a research tool and its potential, both energywise and with respect to precision. Author

N72-13145# Politecnico di Torino (Italy). Ist. di Elettronica e Telecomunicazioni.
ESRO RESEARCH STUDENTSHIP Fin alr eport
Alberto BarciaCancio (Escuela Tec. Superior de Ingr. de Telecomun., Madrid) 31 May 1971 50 p refs Sponsored by ESRO
Avail: NTIS

CONTENTS:
1. RADIATION AND DIFFRACTION PROBLEMS ANALYSED WITH THE MODAL METHOD 32 p (See N72-13146 04-07)
2. ANTENNAS 14 p refs (See N72-13147 04-07)

N72-13146# Politecnico di Torino (Italy). Ist. di Elettronica e Telecomunicazioni.
RADIATION AND DIFFRACTION PROBLEMS ANALYSED WITH THE MODAL METHOD
In Polytec. di Torino ESRO res. studentship 31 May 1971 32 p (See N72-13145 04-07)
Avail: NTIS

Microwave propagation and diffraction in a circular coordinate waveguide is treated as an electromagnetic field problem based on Maxwell's equations. The total field solutions for the electric and magnetic field vector can be considered as composed of the sum of more elementary vector components (modes). Thus the problem is reduced to finding the amplitude and directions of the mode vectors. The problem is solved for homogeneous and nonhomogeneous waveguides using Green's function. An application to waveguides with wedges is indicated. ESRO

N72-13147# Politecnico di Torino (Italy). Ist. di Elettronica e Telecommunicazioni.
ANTENNAS
In Polytec. di Torino ESRO res. studentship 31 May 1971 14 p refs (See N72-13145 04-07)
Avail: NTIS

The design of a Cassegrain antenna for satellite communication is reported. A centered subreflector antenna with corrected subreflector surfaces was chosen in order to obtain nearly uniform amplitude and phase illumination, as well as low subreflector spillover. The feed horn is conical with dual-mode excitation. The axial symmetry permits any type of polarization to be used, and the dual-mode feature reduces subreflector spillover and, consequently, noise temperature. ESRO

N72-13148# AEG-Telefunken, Backnang (West Germany).
COMMUNICATIONS SATELLITE PROJECT, PART 2: SEMICONDUCTOR COMPONENTS AND FREQUENCY CONVERTERS [PROJEKT NACHRICHTENSATELLIT. TEILBERICHT 2: HALBLEITER-BAUELEMENTE UND FREQUENZUMSETZER]
Alfred Bachmeier, Sieghard Bertsch, Reiner Flocken, Guenter Jakob, and Hans-Peter Schiller Bad Godesberg, West Ger. Bundesmin. fuer Bildung und Wiss. Jul. 1971 176 p refs In GERMAN; ENGLISH summary Bundesmin. fuer Bildung und Wiss.
(BMBW-FB-W-71-33) Avail: NTIS; ZLDI Munich: 36,60 DM

CONTENTS:
1. THE 10 A SWITCHING TRANSISTOR p 8-30 (See N72-13149 04-09)
2. HIGH VOLTAGE SWITCHING DIODE p 31-64 (See N72-13150 04-09)
3. MODULATION DIODE p 65-119 (See N72-13151 04-09)
4. FREQUENCY CONVERTERS p 120-174 (See N72-13152 04-09)

N72-13149# AEG-Telefunken, Backnang (West Germany).
THE 10 A SWITCHING TRANSISTOR [10 A-SCHALTTRANSISTOR] c09
In its Commun. Satellite Proj. Jul. 1971 p 8-30 refs In GERMAN (See N72-13148 04-07)
Avail: NTIS; ZLDI Munich: 36,60 DM

The development of a silicon-controlled rectifier (SCR), and subsequently a 10 ampere switching transistor is reported. An electronically controlled switch was used for the power supply to the traveling wave tube and the main controller of the telecommunication part of a communications satellite. A choice had to be made between a turn-off SCR and a correspondingly designed switching transistor. The choice finally was for a specially adapted transistor because of its low saturation current, and a turn-off time shorter than 1 microsecond. ESRO

N72-13150# AEG-Telefunken, Backnang (West Germany).
HIGH VOLTAGE SWITCHING DIODE [HOCHSPANNUNGS-SCHALTDIODE] c09
In its Commun. Satellite Proj. Jul. 1971 p 31-64 refs In GERMAN (See N72-13148 04-07)
Avail: NTIS; ZLDI Munich: 36,60 DM

The development of a high voltage silicon switching diode is reported. The diode was intended for rectification of rectangular alternating current in the power supply for a communications satellite traveling wave tube. Manufacturing technologies were compared, and the double diffusion MCSA technology chosen. In addition, irradiation tests with 1.5 MeV were carried out. The changes noted after irradiation are illustrated by characteristic curves for barrier-layer capacitance, forward current, inverse current, and switching behavior. ESRO

N72-13151# AEG-Telefunken, Backnang (West Germany).
MODULATION DIODE [MODULATIONSDIODE] c09
In its Commun. Satellite Proj. Jul. 1971 p 65-119 refs In GERMAN (See N72-13148 04-07)
Avail: NTIS; ZLDI Munich: 36,60 DM

The development of a modulation diode for a satellite transponder, with a hyper abrupt p-n junction is described. The diode was to be employed for the modulation of a frequency modulated oscillator. This type of diode has a junction capacitance which varies with the reverse voltage in such a manner that for a certain range, a linear relationship exists between oscillator frequency and applied voltage. The manufacture of silicon and germanium modulation diodes is described, and electron irradiation of the germanium diode is reported. Preliminary results point to the superiority of the silicon planar diode due to higher manufacturing reliability, and smaller reverse current. ESRO

N72-13152# AEG-Telefunken, Backnang (West Germany).
FREQUENCY CONVERTERS [FREQUENZUMSETZER] c09
In its Commun. Satellite Proj. Jul. 1971 p 120-174 refs In GERMAN; ENGLISH summary (See N72-13148 04-07)
Avail: NTIS; ZLDI Munich: 36,60 DM

The development and testing of frequency converters for the transponder of a communication satellite are described. The device converts the intermediate frequency (IF) band of the transponder into the transmitter frequency band. It consists of an IF matching amplifier and a balanced mixer. Two models for the transponder bands 255-480 MHz, and 520-475 MHz were developed, and possible solutions were formed for miniaturization. A mixer and high frequency band pass filter were developed in strip line technology. Mechanical and thermal tests were carried out on a functional model. ESRO

N72-13153# AEG-Telefunken, Backnang (West Germany).
COMMUNICATIONS SATELLITE PROJECT, PART 3: CARRIER SUPPLY, TRANSMITTING STAGE AND COOLED PARAMETRIC AMPLIFIER [PROJEKT NACHRICHTENSATELLIT, TEILBERICHT 3: TRAEGERVERSORGUNG, SENDESTUFE UND GEKUEHLTER PARAMETRISCHER VERSTAERKER]
Jork Bretting, Martin Emmerling, Wolf-Rainer Ilenburg, Siegfried Lechler, Horst Luksch, Helmut Nickel, Helmut Poechmueller, Manfred Schwenzel, and Arnulf Wallrabe Bad Godesberg, West Ger. Bundesmin. fuer Bildung und Wiss. Jul. 1971 205 p refs In GERMAN; ENGLISH summaries Sponsored by Bundesmin. fuer Bildung und Wiss.
(BMBW-FB-W-71-34) Avail: NTIS; ZLDI Munich: 42,65 DM

CONTENTS:
1. CARRIER SUPPLY p 4-44 (See N72-13154 04-07)
2. TRANSMITTER STAGE OF A COMMUNICATIONS SATELLITE. CONTRIBUTIONS TO THE TRAVELING WAVE TUBE TL 4002, ITS POWER SUPPLY, AND SWITCHING CIRCUITS p 45-187 (See N72-13155 04-07)
3. COOLED PARAMETRIC AMPLIFIER p 188-203 (See N72-13156 04-07)

N72-13154# AEG-Telefunken, Backnang (West Germany).
CARRIER SUPPLY [TRAEGERVERSORGUNG]
In its Commun. Satellite Proj. Jul. 1971 p 4-44 refs In GERMAN; ENGLISH summary (See N72-13153 04-07)
Avail: NTIS; ZLDI: 42,65 DM

A description is given of a quartz crystal controlled carrier wave supply for the transmitter part of the transponder for a communications satellite being developed for the German-French project Symphonie. Oscillator signals are supplied for all four up- and down-converters by one single oscillator chain, consisting of a quartz-controlled master oscillator and a multiplier chain. Design and mode of operation are described, quoting electrical data and reporting on the results of measurements and some environmental tests. ESRO

N72-13155# AEG-Telefunken, Backnang (West Germany).
TRANSMITTER STAGE OF A COMMUNICATIONS SATELLITE. CONTRIBUTIONS TO THE TRAVELING WAVE TUBE 4002, ITS POWER SUPPLY, AND SWITCHING CIRCUITS [SENDESTUFE EINES NACHRICHTENSATELLITEN. BEITRAEGE SATELLITENWANDERFELDROEHRE TL 4002, NETZGERAET FUER DIE WANDERFELDROEHRE TL 4002, SCHALTEINRICHTUNGEN]
In its Commun. Satellite Proj. Jul. 1971 p 45-187 refs In GERMAN; ENGLISH summary (See N72-13153 04-07)
Avail: NTIS; ZLDI Munich: 42,65 DM

A transmitter stage for the transponder of a communications satellite, under development for the German-French Symphonie project and consisting of a traveling wave tube, power supply, switching circulator, and couplers, is described. Special attention was given to lifetime tests of the solid state signal generator used as feed generator for the traveling wave tube. The equipment satisfies the specifications for electrical testing, but temperature compensation of the circulators and further integration of the equipment is still necessary. ESRO

N72-13156# AEG-Telefunken, Backnang (West Germany).
COOLED PARAMETRIC AMPLIFIER [GEKUEHLTER PARAMETRISCHER VERSTAERKER]
In its Commun. Satellite Proj. Jul. 1971 p 188-203 refs In GERMAN; ENGLISH summary (See N72-13153 04-07)
Avail: NTIS; ZLDI Munich: 42,65 DM

A cooled parametric amplifier for use in a satellite communication ground station is described, having low noise temperature (20-25K) and a bandwidth of up to 500 MHz. As a first step, a double tuned refrigerated parametric amplifier was developed to study the problems of cryogenics, particularly noise temperature. By increasing the idler frequency and using triple tuning it was possible to increase the bandwidth to 500 MHz. A two stage amplifier of this type has not yet been completed. Several partial problems in cryogenics and diode techniques were solved. ESRO

N72-13157# European Space Research Organization, Paris (France).
THE EUROPEAN PROGRAMME OF TELEPHONY AND TELEVISION DISTRIBUTION SATELLITES
J. P. Contzen [1971] 12 p
(N/339) Avail: NTIS

Basic features of a European program of telephony and television distribution satellites as envisaged by ESRO are discussed. The topics include: program objectives, frequency bands, transmission techniques, and spacecraft characteristics. ESRO

N72-13158# Royal Inst. of Tech., Stockholm (Sweden). Div. of Electron Physics.
COMPUTER PROGRAM FOR CALCULATION OF ELECTRICAL PARAMETERS IN CAVITY RESONATORS WITH CYLINDRICAL SYMMETRY
M. Sedlacek Sep. 1971 75 p refs
(TRITA-EPP-71-06) Avail: NTIS

A computer program is described based on the relaxation method, which calculates the following parameters of a symmetrical cavity resonator: (1) resonant frequency in MHz, (2) stored energy in joules/cu m, (3) total stored energy in joules, (4) power loss on cavity walls, (5) Q factor, (6) shunt impedance in Mohm and Mohm/m, and (7) normal electric field on the boundary in MV/m. The program is divided in four parts: (1) the geometrical treatment, (2) the relaxation, (3) the calculation of the electrical parameters, and (4) a user-written subroutine (optional). The preparation of input data meeting certain boundary conditions is described, and an abridged flow diagram is given. The program is suitable for an overlay structure. Results of tests with an Alvarez and a Los Alamos type cavity are reported. ESRO

N72-13159# Helsinki Univ. (Finland). Radio Lab.
GRID ANTENNA ARRAY FOR VHF INCOHERENT SCATTER RADAR
Martti Tiuri, Stefan Tallqvist, and Seppo Urpo Aug. 1971 16 p refs

(S-40-1971) Avail: NTIS

The possibility of using a wire grid antenna array for VHF (240 MHz) incoherent radar scatter is considered. Theoretical results and measurements of scale models and a full-size model of grid antennas are presented. An antenna consisting of an array of 68 pairs of grid antennas is proposed. The results are compared to the existing Ficamarca antenna (crossed dipoles), and shows the following advantages: greater resistance to the Arctic climate, larger range of beam steering, and remote beam steering. ESRO

N72-13160# Helsinki Univ. (Finland). Radio Lab.
ON WAVE-NORMAL AND RAY SURFACES OF GENERAL ANISOTROPIC MEDIA
Ismo V. Lindell 1971 6 p refs
(S-41-1971) Avail: NTIS

Dyadic calculus is applied to the classicial problem of propagation of an electromagnetic discontinuity in a general anisotropic medium. It is shown that the eikonal and ray equations, and hence the equations of the wave normal and ray surfaces, take a coordinate-independent explicit form. ESRO

N72-13161# Helsinki Univ. (Finland). Radio Lab.
ON THE DEFINITENESS OF THE CONSTITUTIVE PARAMETERS OF A MOVING ANISOTROPIC MEDIUM
Ismo V. Lindell 1971 6 p refs
(S-42-1971) Avail: NTIS

Using coordinate independent dyadic notation the constitutive parameters of a moving medium are derived in a form that is more concise than what is obtained if the conventional matrix methods are used. The result allows a study on the definite character of the constitutive parameters. It is found that parameters for a moving medium are positively definite if and only if the velocity of the medium does not exceed the ray velocity of the medium. Author (ESRO)

N72-13162# Navy Electronics Lab., San Diego, Calif.
WKB MODE SUMMING PROGRAM FOR VLF/ELF ANTENNAS OF ARBITARY LENGTH, SHAPE AND ELEVATION Interim Report
Richard A. Pappert and Linda R. Shockey 2 Jun. 1971 42 p refs
(DASA-MIPR-71-555)
(AD-728414; NELC-IR-713; NELC-M402; DASA-Subtask-HB-042) Avail: NTIS CSCL 20/14

The report presents a Fortran IV program which allows for WKB mode sum calculations of the three electric field components E sub x, E sub y and E sub z at any height within the guide and for transmitting antennas of arbitrary length and shape. Author (GRA)

N72-13163# Admiralty Surface Weapons Establishment, Portsmouth (England).
AN X-BAND NANOSECOND RADAR FOR LABORATORY USE
A. C. Large Feb. 1971 12 p ref
(AD-729779; TR-71-3; NSTIC-29678; TR-71-3) Avail: NTIS CSCL 17/9

A simple very short pulse low power radar is described. The pulse rise time is about 1.5 nanoseconds giving the radar a minimum range resolution of 20 cm. Objects down to 0.002 sq meters echoing area have been measured on an indoor 12 meter site. Author

N72-13164# Lincoln Lab., Mass. Inst. of Tech., Lexington.
AN ACQUISITION AND TRACKING RECEIVER FOR SATELLITE TO SATELLITE RELAYING AT 55 GHz
Stephen L. Zolnay 11 May 1971 41 p refs
(Contract F19628-70-C-0230; AF Proj. 649L)
(AD-728626; TN-1971-29; ESD-TR-71-141) Avail: NTIS CSCL 17/2

The note deals with the design of an acquisition and tracking system for inter-satellite communication. The problems of acquisition and tracking of position and of frequency are addressed. These are defined for the planned LES-8 and -9 satellites and a system design is proposed. The anticipated performance of the system is evaluated. Author (GRA)

N72-13165# Naval Postgraduate School, Monterey, Calif.
A SONAR DETECTION MODEL M.S. Thesis
Richard Charles Curley Mar. 1971 58 p refs
(AD-728580) Avail: NTIS CSCL 17/1

The report modifies an existing sonar range prediction model for the AN/SQS-23 in such a manner as to attain detection range data in consonance with exercises from which the original data was extracted. It also shows personnel a method for incorporating more than one ship in the model. This model will assist users in ascertaining the number of units required to perform a given antisubmarine task. Author (GRA)

N72-13166# Army Electronics Command, Fort Monmouth, N.J.
COMPARISON BETWEEN COMPUTER-CONTROLLED TROPOSCATTER SIMULATION AND AN ACTUAL LINK
William A. Olsen May 1971 46 p refs
(AD-728102; ECOM-3423) Avail: NTIS CSCL 17/2

The purpose of this report is to compare a computer-controlled troposcatter simulation with data obtained over an actual troposcatter test link. Parameters compared are fade rate, signal amplitude, and fade duration and correlation coefficient distributions, as well as error rates obtained with various high speed digital models. Author (GRA)

N72-13167# Chicago Univ., Ill. Lab. for Atmospheric Probing.
THE ESTIMATION OF SPECTRAL MOMENTS Ph.D. Thesis - Ill. Inst. of Tech.
Jeffrey Neil Deneberg May 1971 98 p refs
(Contract N00014-67-A-0285-0014; Grant NSF GA-27680X)
(AD-728798; TR-23) Avail: NTIS CSCL 09/4

The results of an investigation that considered the real time estimation of certain shape parameters of the power spectral density of a narrow band random process are presented. Systems are developed which directly estimate f sub a, the power mean frequency, and B, the standard deviation of the spectrum. The equivalence of these estimators to the classical estimators is demonstrated and simple implementations, due to the omission of the intermediate computation of spectrum estimates, are presented. Statistical analyses are made for both estimators under the assumption of long time averaging and a Gaussian input process. It is demonstrated that both estimators are asymptotically unbiased and that their mean square errors tend to zero, with order 1/T, as the averaging time goes to infinity. Author (GRA)

N72-13168# IIT Research Inst., Chicago, Ill.
STUDY OF CONCEPTS FOR NAVY COMMUNICATIONS
Robert V. Janc Sep. 1971 9 p
(Contract N00014-70-C-0375; NR Proj. 274-118)
(AD-728801; IITRI-E6174-8-Add) Avail: NTIS CSCL 17/2

The Technical Report of Contract N00014-70-C-0375 (AD-724340) was submitted in May 1971. Since that time, in continuing the work on the contract, an error was found in the mathematical development encompassing nets which utilize more than one frequency. The impact of the error on the observations and conclusions relative to net performance published in the Technical Report is insignificant and no changes in them are required. However, since others might attempt to extend this work using the mathematical expressions derived in this report, this addendum is being published to identify the error, and to show the effect of this error on the results obtained. In addition a brief description of the corrected mathematical development is also included. A subsequent report will contain a complete corrected mathematical development. Author (GRA)

N72-13169# International Business Machines Corp., Gaithersburg, Md. Federal System Div.
EXPANSION AND COMPRESSION BUFFERS FOR THE PHASE 2 DSCS TDMA: DESIGN PLAN, EXHIBITS 1, 3, AND 4
Feb. 1971 123 p
(Contract DAAB07-70-C-0203)
(AD-728513; FSC-71-5040) Avail: NTIS CSCL 17/2

The design plan, which consists of four parts, documents the design information pertaining to the recommended expansion (or receive) and compression (or transmit) buffers for DSCS 2 TDMA. Exhibit 1 is the functional specification in which the relaton between the expansion and compression buffers and the TDMA system are established. In this context the logical, physical, and operational aspects of the buffer are specified. Exhibit 2 (separately bound) provides the logic design details of the data flow units specified in Exhibit 1. The component list is given in Exhibit 3 and identifies critical components and vendor sources. Exhibit 4 shows the recommended 15-month development plan for an advanced development model of the buffer. Author (GRA)

N72-13170# International Business Machines Corp., Gaithersburg, Md. Federal Systems Div.
EXPANSION AND COMPRESSION BUFFERS FOR THE PHASE 2 DSCS TDMS: DESIGN PLAN, EXHIBIT 2
Feb. 1971 302 p
(Contract DAAB07-70-C-0203)
(AD-728514; FSC-71-5040) Avail: NTIS HC $6.00/MF $0.95 CSCL 17/2

The document contains logic circuit diagrams for the DSCS TDMA system including the following: Transmit data commutator; Receive data recommutator; Transmit data subchannel; Receive data subchannel; Memory expansion card; MOF steering logic, MOF control logic. GRA

N72-13171# International Business Machines Corp., Gaithersburg, Md. Federal Systems Div.
EXPANSION AND COMPRESSION BUFFERS FOR THE PHASE 2 DSCS TDMA Final Report
Feb. 1971 75 p
(Contract DAAB07-70-C-0203)
(AD-728517; FSC-71-5039) Avail: NTIS CSCL 17/2

The report documents the investigation performed in establishing the design recommendations concerning the compression (or transmit) and expansion (or receive) buffers that satisfy the TDMA requirements for DSCS 2. A TDMA network model provided by USASATCOMA was the basis used to establish the requirements imposed upon the buffers. Memory and control logic technologies were surveyed to establish the state-of-the-art of components to be used in the design of the buffers. Candidate buffer configurations that satisfy the requirements were established using the promising memory technologies and traded off using cost, flexibility, growth potential, reliability and availability as the criterion. The recommended buffer system for TDMA was designed and a summary of the logical, physical and operational aspects of the buffer design are included. More detailed design information will be found in the Design Plan. Author (GRA)

N72-13172# Chicago Univ., Ill. Lab. for Atmospheric Probing.
SENSITIVITY CALIBRATION OF A DIAL BEAM VERTICALLY POINTING FM-CW RADAR
Ernst Stratmann, David Atlas, Douglas R. Jensen (NELC), and Juergen H. Richter (NELC) 20 Apr. 1971 34 p refs Prepared in cooperation with IIT and NELC
(Grant DA-ARO(D)-31-124-71-G71; ap-01369-01)
(AD-728804; TR-21) Avail: NTIS CSCL 17/9

A method of calibrating a fixed vertically pointing radar is presented. The technique involves the firing of B-B shot of known radar cross-section through the beam while making successive corrections for trajectory until the absolute maximum signal is attained. The results agree closely with an independent calibration of antenna gain. The approach is particularly suited to an FM-CW radar with high range resolution because the bee-bees reach heights well in excess of the minimum range and errors in range are negligible. Corrections are presented for the reduction in maximum two-way gain resulting from intersecting beams whose full gain is attained only at the point of intersection. Author (GRA)

N72-13173# Santa Rita Technology, Inc., Los Altos, Calif.
SPEECH IN HELIUM: THEORY AND MEASUREMENTS Final Report, 15 Jun. 1969 - 14 Jun. 1970
John L. Stewart Jan. 1971 91 p refs
(Contract N00014-68-C-0405; NR Proj. 145-244)
(AD-726250; Code-454) Avail: NTIS CSCL 17/2

The distortions of speech in a helium-breathing mixture are analyzed with the aid of an analog ear having time resolution sufficient to reveal temporal details of neural volleys as are produced by individual glottal pulses. The several existing techniques for helium speech correction are reviewed. Due to excessive weakening of second formats in helium concentrations greater than 80%, and certain other factors, it is concluded that no scheme yet proposed is likely to be satisfactory in a practical noisy environment. Author (GRA)

N72-13174# Michigan Univ., Ann Arbor. Cooley Electronics Lab.
MODELS FOR NONSTATIONARY STOCHASTIC PROCESSES WITH APPLICATIONS TO UNDERWATER ACOUSTICS
Peter P. Nuspl Jul. 1971 216 p refs
(Contract N00014-67-A-0181-0032)
(AD-729059; Rept-036040-2-T; TR-204) Avail: NTIS CSCL 09/4

Some models for nonstationary stochastic processes with time-varying autocorrelation matrices are presented and applied to real data processes. As probability distributions are complete statistical descriptions of a random variable, the fundamental problems are to find conditional distributions for the process x given observations y in a time interval. The Markov condition and the Gaussian distribution are assumed for the process x. Presuming knowledge of the model parameters, the solutions have been stated as the Kalman-Bucy equations. The model parameters consist of the state-transition matrix, the driving noise covariance matrix and the observation noise covariance matrix. A class of linear filters and digital processors, which have simple computer implementation, is presented. The data acquisition consists of simultaneous processing of hydrophone outputs to produce signal power and noise power measurements of underwater acoustic receptions. The study shows that the signal power process is apparently second-order stochastic and that the second-order model is adequate as a smoothing and prediction filter. The noise process has shipping and biological noise which makes effective modeling difficult; by selective elimination of such observations a study of ambient ocean noise is possible. The models are useful in studying these nonstationary stochastic processes. Author (GRA)

N72-13175# Sage Action, Inc., Ithaca, N.Y.
THE RADAR CROSS SECTION OF EXTREMELY THIN SPHERICAL SHELLS Technical Report, 1 Feb. 1969 - 31 Mar. 1970
R. W. Hale, D. F. Brown, and D. E. Ordway Dec. 1970 52 p refs
(Contract N00014-69-C-0170; NR Proj. 213-042)
(AD-729233; SAI-RR-7003) Avail: NTIS CSCL 17/9

A detailed investigation of the radar cross section (RCS) of extremely thin, spherical shells is described. The shells are taken to be thin enough to be neutrally buoyant in air when filled with a light gas such as helium. The problem is formulated and various approaches for calculating RCS values are explored for both dielectric and conductive shell materials. An exact solution is found to be necessary. The computer codes to carry out this solution are described, together with an extensive set of

numerical results. In addition, a limiting solution is presented which furnishes the analytical basis for a correlation of the exact conductive shell results. This correlation provides a simple, working tool for predicting the RCS of very thin, conductive shells in the resonance region without recourse to the computer code. Author (GRA)

N72-13796*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
RADIO TRACKING WITH THE DEEP SPACE NETWORK
Warren L. Martin *In its* Proc. of the Conf. on Exptl. Tests of Gravitation Theories 1 Nov. 1971 p 158-165 refs (See N72-13776 04-30)
Avail: NTIS CSCL 17B

N72-13808*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THE USE OF THE EARTH-MOON SYSTEM AS A RADIO TRACKING FACILITY
J. Derral Mulholland *In its* Proc. of the Conf. on Exptl. Tests of Gravitation Theories 1 Nov. 1971 p 249-251 refs (See N72-13776 04-30)
Avail: NTIS CSCL 17B

N72-13554*# Wisconsin Univ., Madison.
A DEMONSTRATION OF THE INTERCONTINENTAL DISSEMINATION OF GRAPHIC METEOROLOGICAL DATA UTILIZING TELECOPIERS AND RADIO TELEPHONY
J. A. Weinman, R. C. Grosh, S. D. Ellington, R. Calheiros (Fundacao Educacional de Bauru, Sao Paulo), G. Ferraz (Fundacao Educacional de Bauru, Sao Paulo), C. W. VanScherpenzeel (Meteorologische Dienst v. Suriname, Paramaribo), and E. Dijra (Meteorologische Dienst v. Suriname, Paramaribo) *In its* Meteorol. Meas. from Satellite Platforms Aug. 1971 p 159-165 (See N72-13544 04-20)
Avail: NTIS CSCL 17B

08 COMPUTERS

Includes computer operation and programming; and data processing. For applications, see specific categories. For related information see also: 19 Mathematics

N72-13176# Electrotechnical Lab., Tokyo (Japan).
AN IMPLEMENTATION OF A MACHINE TRANSLATION PROCESSOR
Hirohiko Nisimura Dec. 1970 128 p refs In JAPANESE; ENGLISH summary
(RR-712) Avail: NTIS

A syntax directed translation system named YAMATO was developed. The YAMATO processor is coded in COBOL in a compact form (about 950 lines). It includes only COBOL functions which can be understood in the same way by several compilers. The complete listing and detailed documentation of the processor are given, and the procedure, internal data, and programming technique are discussed. Author

N72-13177*# Computer Sciences Corp., Huntsville, Ala. Field Services Div.
SPACEBORNE COMPUTER EXECUTIVE ROUTINE FUNCTIONAL DESIGN SPECIFICATION. VOLUME 2: COMPUTER EXECUTIVE DESIGN FOR SPACE STATION/BASE
J. R. Kennedy and W. S. Fitzpatrick Washington NASA Oct. 1971 88 p
(Contract NAS8-24930)
(NASA-CR-1868) Avail: NTIS CSCL 09B

The computer executive functional system design concepts derived from study of the Space Station/Base are presented. Information Management System hardware configuration as directly influencing the executive design is reviewed. The hardware configuration and generic executive design requirements are considered in detail in a previous report (System Configuration and Executive Requirements Specifications for Reusable Shuttle and Space Station/Base, 9/25/70). This report defines basic system primitives and delineates processes and process control. Supervisor states are considered for describing basic multiprogramming and multiprocessing systems. A high-level computer executive including control of scheduling, allocation of resources, system interactions, and real-time supervisory functions is defined. The description is oriented to provide a baseline for a functional simulation of the computer executive system. Author

N72-13178# Department of Supply, Melbourne (Australia). Aeronautical Research Labs.
NOISE DUE TO TAPE SPEED FLUTTER IN FREQUENCY MODULATION RECORDING
M. D. Card Apr. 1971 19 p refs
(ARL/FI-14) Avail: NTIS

Sources of tape speed flutter and the interaction between the tape and the head of a magnetic tape transport are examined. An analysis of the effect of tape speed flutter on the recording and reproducing of frequency modulated signals is presented. Further, an expression is derived for the noise components arising during reproduction as a result of flutter. Author

N72-13179# Technische Univ., Berlin (West Germany).
CONTRIBUTION TO THE RECORDING PROCEDURE IN ANALOG MAGNETIC STORAGE TECHNOLOGY WITH HIGH FREQUENCY PRE-MAGNETIZATION Ph.D. Thesis
Manfred Paul 1970 70 p refs In GERMAN
Avail: NTIS

Magnetic characteristics of recording tapes and the mechanism of the recording process are studied by describing the print-through effect with high frequency pre-magnetization through the Preisach Schwantke model. The theory of the printing functions is used to develop a Gaussian distribution for the analytical description of the printing-through density and to calculate sensitivity lines and noise factors. Transl. by G.G.

N72-13180# Eidgenossische Technische Hochschule, Zurich (Switzerland).
MATHEMATICAL COMPUTER MODELS Ph.D. Thesis [MATHEMATISCHE COMPUTER-MODELLE]
Peter Schuler 1970 50 p refs In GERMAN
(Diss-4473) Avail: NTIS

Random access stored program computers are described where the central processor is a working function able to process transfers in successive configurations. A simple self-modifying algorithmic language is developed for the central processor that is also able to interpret higher programming languages. It is shown that for each partial-recursive function, there exists in the same definition region, a partial-recursive function that cannot be determined through the same storage access. Transl. by G.G.

N72-13181# Technische Univ., Berlin (West Germany).
INVESTIGATIONS ON PROBLEM OF COMPUTER CONTROLLED THREE-DIMENSIONAL REPRESENTATIONS OF TWO-DIMENSIONAL PROJECTIONS Ph.D. Thesis
Jose Encarnacao 1971 232 p refs In GERMAN
Avail: NTIS

A computer program for three dimensional graphic displays is developed. Algorithms and implemented solutions are discussed for: three-dimensional projections of bodies that are bounded by level areas, three-dimensional areas given in explicit or parametric forms, and general three-dimensional area representations. Transl. by G.G.

N72-13182*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
PARAMETER IDENTIFICATION USING A CREEPING-RANDOM-SEARCH ALGORITHM
Russell V. Parrish Washington Dec. 1971 36 p refs
(NASA-TN-D-6533; L-7853) Avail: NTIS CSCL 09B

A creeping-random-search algorithm is applied to different types of problems in the field of parameter identification. The studies are intended to demonstrate that a random-search algorithm can be applied successfully to these various problems, which often cannot be handled by conventional deterministic methods, and, also, to introduce methods that speed convergence to an extremal of the problem under investigation. Six two-parameter identification problems with analytic solutions are solved, and two application problems are discussed in some detail. Results of the study show that a modified version of the basic creeping-random-search algorithm chosen does speed convergence in comparison with the unmodified version. The results also show that the algorithm can successfully solve problems that contain limits on state or control variables, inequality constraints (both independent and dependent, and linear and nonlinear), or stochastic models. Author

N72-13183*# International Business Machines Corp., Huntsville, Ala. Electronics Systems Center.
A GUIDE TO ONBOARD CHECKOUT. VOLUME 5: DATA MANAGEMENT
Sep. 1971 170 p
(Contract NAS9-11189)
(NASA-CR-115257; IBM-71W-00312-Vol-5) Avail: NTIS CSCL 09B

The baseline data management subsystem for a space station is discussed. The subsystem consists of equipment necessary to transfer, store, and process data to and from users and subsystems. It acquires and conditions a wide variety of inqut data from experiments, vehicle subsystems sensors, uplinked ground communications, and astronaut-activated controls. Computer techniques for failure analysis, reliability, and maintenance checkout onboard the space station are considered. K.P.D.

N72-13184*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AUTOMATIC COMPUTER SUBPROGRAM SELECTION FROM APPLICATION PROGRAM LIBRARIES
Joseph M. Drozdowski Washington Jan. 1972 54 p refs
(NASA-TM-X-2441; L-8024) Avail: NTIS CSCL 09B

The program ALTLIB (ALTernate LIBrary) which allows a user access to an alternate subprogram library with a minimum effort is discussed. The ALTLIB program selects subprograms from an alternate library file and merges them with the user's program load file. Only subprograms that are called for (directly or indirectly) by the user's programs and that are available on the alternate library file will be selected. ALTLIB eliminates the need for elaborate control-card manipulations to add subprograms from a subprogram file. ALTLIB returns to the user his binary file and the selected subprograms in correct order for a call to the loader. The user supplies the alternate library file. Subprogram requests which are not satisfied from the alternate library file will be satisfied at load time from the system library. Author

N72-13185*# Maryland Univ., College Park. Computer Science Center.
ARCHITECTURAL DESIGN OF AN ALGOL INTERPRETER
Claude K. Jackson Sep. 1971 99 p refs
(Grants NGR-21-002-197; NGL-21-002-008)
(NASA-CR-124741; TR-168) Avail: NTIS CSCL 09B

The design of a syntax-directed interpreter for a subset of Algol is described. It is a conceptual design with sufficient details and completeness but as much independence of implementation as possible. The design includes a detailed description of a scanner, an analyzer described in the Floyd-Evans productions, a hash-coded symbol table, and an executor. Interpretation of sample programs is also provided to show how the interpreter functions. Author

N72-13186*# Maryland Univ., College Park. Computer Science Center.
ARCHITECTURAL DESIGN AND SIMULATION OF A VIRTUAL MEMORY
Gee-Yin Kwok and Yaohan Chu Jan. 1971 78 p refs
(Grant NGR-21-002-197)
(NASA-CR-124837; TR-170) Avail: NTIS CSCL 09B

Virtual memory is an imaginary main memory with a very large capacity which the programmer has at his disposal. It greatly contributes to the solution of the dynamic storage allocation problem. The architectural design of a virtual memory is presented which implements by hardware the idea of queuing and scheduling the page requests to a paging drum in such a way that the access of the paging drum is increased many times. With the design, an increase of up to 16 times in page transfer rate is achievable when the virtual memory is heavily loaded. This in turn makes feasible a great increase in the system throughout. Author

N72-13187# Los Alamos Scientific Lab., N.Mex.
DCHAIN: A PDP-9/PDP-15 COMPUTER PROGRAM FOR RADIOACTIVE DECAY AND CAPTURE CHAIN CALCULATIONS
Larry V. East Jun. 1971 10 p refs
(Contract W-7405-eng-36)
(LA-4708) Avail: NTIS

A program written to calculate the time-dependent populations of radioactive decay and neutron capture chains is described. The program was written in FORTRAN 4, and intended for use on a DEC PDP-9 or PDP-15 computer. A complete program listing and sample calculations are included. Author (NSA)

N72-13188# Auburn Univ., Ala. Digital Systems Lab.
ADAPTIVE REPLACEMENT ALGORITHMS FOR USE IN PAGED MEMORY COMPUTER SYSTEMS
C. C. Carroll and J. M. Thorington, Jr. Jul. 1971 170 p refs
(Contract DAAH01-68-C-0296)
(AD-725989; THEMIS-AU-T-18) Avail: NTIS CSCL 09/2

Virtual memory computers are studied with particular emphasis on paged memory systems. Existing replacement algorithms are analyzed and a need for new and improved algorithms is demonstrated. Three new replacement algorithms which utilize adaptive techniques are designed. A probability model that produces "typical" memory traces is developed and a FORTRAN 4 computer program that implements this model is provided. Using the memory traces generated by the probability model, a simulation study of the new adaptive algorithms and the extant algorithms is described. The results of this study indicate that one of the new algorithms is significantly better than any of the existing ones. A GPSS queuing model simulation of a complete multiprogrammed paged memory computer system is given. A discussion of the manner in which improved algorithms affect system performance is provided. Possible physical implementations of the best new algorithm are studied and a design, constructible with present state-of-the-art digital hardware, is derived. Author (GRA)

N72-13189# Naval Postgraduate School, Monterey, Calif.
A SOFTWARE PACKAGE FOR ANALYSIS OF GEOPHYSICAL MEASUREMENTS M.S. Thesis
John Frederick Arfman, Jr. Jun. 1971 69 p refs
(AD-728577) Avail: NTIS CSCL 09/2

A software package for general analysis of real time series for geophysical data was developed. The package consists of FORTRAN IV callable subprograms that are assigned different tasks such as input, output (either printed or graphical), initial data analysis and filtering, spurious data rejection, FFT, and spectral analysis. A geophysical problem involving detection of unusual deep ocean pressures was analyzed. Author (GRA)

N72-13190# Picatinny Arsenal, Dover, N.J.
INTERACTIVE GRAPHICS AT PICATINNY ARSENAL
Robert I. Isakower Jun. 1971 76 p
(AD-728808; PA-TR-4241) Avail: NTIS CSCL 09/2

A number of scientific and engineering applications at Picatinny Arsenal were investigated to evaluate potential benefits which might accrue from the use of computer graphics. It was found that most of the potential applications are now being served to some extent by conventional computing methods. Many of these would benefit substantially from the interactive process afforded by the use of graphical display terminals. Four areas were proposed for initial implementation. In these areas the early benefits of computer graphics would be greatest because computer programs now exist which can perform the basic analysis, and because the programs can be adapted to graphical techniques with a reasonable amount of effort. Additional applications have been identified in which the use of graphical techniques would be extremely valuable, but would require far more extensive computer software development to support this implementation. Author (GRA)

N72-13191# Alabama Univ., University. Bureau of Engineering Research.
BENDING AND BUCKLING OF A ONE DIMENSIONAL MODEL SIMULATING A CONICAL SHELL
Chin Hao Chang Jul. 1971 139 p refs
(Contract DAAH01-70-C-0862)
(AD-728470; BER-132-97-Pt-1; Task-3.2.9) Avail: NTIS CSCL 09/2

A new method for analysis of bending and buckling of conical shells is presented. The method shows that a constraint of conical shells can be brought into the system by the variational method in conjuntion with the Lagrange multiplier. The constraint was erroneously considered as a boundary condition in most of the literature. The method is demonstrated by a one dimensional model which simulates an element of a symmetrically deformable elastic conical shell. A set of equations for bending of large deflection and buckling for the model is derived. The exact solutions of one element with both ends simply supported are given. A finite difference solution and a corresponding computer program is presented which determines the nonlinear axisymmetric static response of thin shells of revolution. The boundary conditions are taken in a general form which allows the program to handle any combination of elastic restraints at the edges. The analysis and computer program are described in detail and sample calculations are included.
Author (GRA)

N72-13192# RCA International Service Corp., Patrick AFB, Fla.
A PROGRAM FOR MANIPULATING RATIONAL FUNCTIONS OF POLYNOMIALS
Sheldon D. Jordan and Donald B. Gennery AFETR Aug. 1971 29 p refs Presented at the 10th Ann. Southeastern Reg. Conf. bf ACM Assoc. for Computing Machinery, Mobile, Ala., Jun. 1971
(Contract F08606-68-C-0040; Missile Test Proj.)
(AD-728730; AFETR-TR-71-3; Tech-Paper-5300-71-1) Avail: NTIS CSCL 09/2

Many problems in engineering and mathematics require the manipulation of polynomials. Methods for doing this which are adaptable to digital computer use range from the symbolic algebra method to the purely numerical methods. The polynomial algebra method, which lies somewhere between these two extremes, has been implemented in an interpreter called HPAL. Instead of simple polynomials, the variables in this method are rational algebraic functions represented as ratios of products of polynomials (which are themselves represented symbolically). The potential inherent in the HPAL approach to polynomial manipulation in digital computers is illustrated by the example of a radar antenna servo analysis. Author (GRA)

N72-13193# Naval Postgraduate School, Monterey, Calif. Dept. of Mathematics.
THE USE OF AN AUXILIARY COMPUTER WITH A GRAPHIC DISPLAY AS AN ON-LINE DEBUGGING AID M.S. Thesis
Elton Truxton Ashby, Jr. Jun. 1971 85 p refs
(AD-728719) Avail: NTIS CSCL 09/2

Often, the most time consuming and costly evolution in the development of computer programs and systems is the testing of the programmer's logic. There are many tools and techniques available which aid the programmer in detecting logic errors, but all have characteristics which limit their usefulness. The objective of this research was to develop a system which uses an ADAGE AGT-10 as an auxiliary computer with a graphic display to provide facilities for monitoring a program which is running on the XDS-9300 computer. The system developed and implemented enables the programmer to stop the execution of his program, display the memory contents of the 9300, change the memory contents as required, and then continue the execution of his program. The thesis includes information on the use of the system and a detailed discussion of the implementation.
Author (GRA)

N72-13194# Naval Postgraduate School, Monterey, Calif.
A GRAPH THEORETIC APPROACH TO THE CLASS SCHEDULING PROBLEM M.S. Thesis
Charles Lewis Deitrick Jun. 1971 53 p refs
(AD-728673) Avail: NTIS CSCL 12/2

Two algorithms for coloring large order graphs by partitioning, as related to class scheduling with a computer, are developed. Although, the two main algorithms failed to produce acceptable results for application to class scheduling, a coloring algorithm developed for use in the two main algorithms is an improvement over known existing coloring algorithms. Author (GRA)

N72-13195# Army Materiel Systems Analysis Agency, Aberdeen Proving Ground, Md.
SEQOPT: A SOLUTION TO THE FORCE STRUCTURING PROBLEM
Wayne S. Copes Jun. 1971 64 p
(DA Proj. 1P7-65801-MM-11)
(AD-728499; AMSAA-TM-108) Avail: NTIS CSCL 16/3

The SEQOPT has been designed to solve a specific force structuring and allocation problem. Given the following: a set of targets each with a relative value and an associated single shot kill probability; a set of launch points for weapons and the number of weapons allowed at each launch point; the payload types available for use in these weapons; and the set of accessible targets for a weapon carrying each payload type from every launch point. The SEQOPT will then determine the payload type for each weapon in the force, and the allocation bf each weapon to its set of accessible targets, in a way which attempts to maximize the expected damage to the target complex.
Author (GRA)

N72-13196# Naval Postgraduate School, Monterey, Calif.
TIME SHARED COMPUTER PROGRAMS FOR OFFICER STRUCTURE POLICY PLANNING M.S. Thesis
Frank William Reifsynder, Jr. Jun. 1971 63 p refs
(AD-728697) Avail: NTIS CSCL 05/9

The thesis develops two personnel flow models which can aid the manpower policy planner to predict future officer structures through the use of a time-shared computer system. The underlying structure is presented for both models. One model considers promotions based on length of commissioned service. The other model considers promotions based on length of time in grade. Computer programs are developed for both models and sample outputs are shown. The programs are used on a time-shared computer system so that the policy planner can interact with the computer with a minimal knowledge of computer programming. The computer output is in a concise, easy to understand form. Author (GRA)

N72-13197# Naval Postgraduate School, Monterey, Calif.
EO 1: A COMPILER APPROACH TO MACHINE PROBLEM SOLVING M.S. Thesis
Ronald Glenn Osborne Jun. 1971 77 p refs
(AD-728689) Avail: NTIS CSCL 09/2

The work described herein should be viewed as experimental research in the area of machine problem-solving. The essence of such study is the utilization of a digital computer for the discovery of problem solutions in regions which normally require the human faculty labelled intelligence. The domain of this effort was elementary Plane Geometry, including all of the assumptions, theorems and corollaries (and their associated exercises) normally considered in a first course. The ultimate goal was a machine which could attain a passing score on a final examination over the subject matter. The vehicle employed is a sizable computer program, designed and implemented under the facilities of a compiler generating system for execution on the IBM System 360. Author (GRA)

N72-13198# Aerophysics Research Corp., Bellevue, Wash.
COMBAT OPTIMIZATION ANALYSIS PROGRAM: COAP. VOLUME 2: PROGRAM USER'S MANUAL Final Report, Sep. 1969 - Dec. 1970
D. S. Hague, R. T. Jones, and C. R. Glatt May 1971 302 p refs
(Contract F33615-70-C-1036; AF Proj. 1431)
(AD-729180; AFFDL-TR-71-52-Vol-2) Avail: NTIS HC$6.00/MF $0.95 CSCL 09/2

COAP is a program for the simulation and optimization of combative and cooperative two-vehicle flight paths. It includes single vehicle flight path problem capability as a subcase. Considerable emphasis is placed on the use of modern optimization. The program has the ability to perform trajectory optimization by the variational steepest-descent method including search for optimal initial conditions; search for optimal arc (stage) lengths; constraints defined at terminal point, intermediate corners (stage points), or along the path; and optimum parameter (design variable) values. The program can solve two system (vehicle) problems with or without reacting feedback from the second system (vehicle). Alternatively, the program may be used to apply the direct multivariable search approach to trajectory optimization. A variety of multivariable search algorithms are available in this mode including elemental perturbation (one parameter at a time); organized first- and second-order methods, and randomized methods. A method of solution for problems exhibiting multiple extremals and a procedure for the location of saddle points is also included. Author (GRA)

N72-13957# Royal Swedish Academy of Engineering Sciences, Stockholm.
EDP AND ITS UTILIZATION
In its Develop. in Res. and Technol. during 1970 1970 p 152-157 ref In SWEDISH (See N72-13942 04-34)
Avail: NTIS; Almqvist & Wiksell, Stockholm: 25 Kr

09 ELECTRONIC EQUIPMENT

Includes electronic test equipment and maintainability; component parts, e.g., electron tubes, tunnel diodes, transistors; integrated circuitry; microminiaturization. For basic research see: 10 Electronics. For related information see also: 07 Communications and 21 Navigation.

N72-13199 National Lending Library for Science and Technology, Boston Spa (England).
HIGH-VOLTAGE CERAMIC CONDENSERS
N. P Bogoroditskii et al Oct. 1971 34 p refs Transl. into ENGLISH from Vysokovoltnye Keram. Kondensatory (Moscow), 1970 p 44-89
(NLL-RTS-6607) Avail: Natl. Lending Library, Boston Spa, Engl.: £3.40; 11 NLL photocopy coupons

The available literature on the breakdown of solid dielectric materials is reviewed and hitherto unpublished results of investigations into the electrical strengths of radio-ceramics are produced. Breakdowns are classified as thermal, electrical and electrochemical failures of solid dielectrics. The initiation of breakdown by one or other of these causes is determined by the characteristics of the dielectric, the nature and length of application of the stress, the cooling conditions, etc. Author

N72-13200# Electrotechnical Lab., Tokyo (Japan).
CONTROL OF HIGH ENERGY CAPACITOR BANKS
Masaru Sugiura, Nagayasu Ikeda, Masayuki Iguchi, and Shohei Takeda Jan. 1971 116 p refs In JAPANESE; ENGLISH summary
(RR-713) Avail: NTIS

Techniques for the control of high energy capacitor banks are described. The techniques were developed during thermonuclear fusion research and the background of the research is presented. The characteristics of spark gap switches are discussed. The triggering characteristics of spark gaps were measured for an over-voltage triggering system. The characteristics are shown by a single curve after defining an over-voltage factor in which all the parameters affecting the triggering characteristics are included and normalized. Author

N72-13201*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
NONLINEAR, NONLAMINAR-3D COMPUTATION OF ELECTRON MOTION THROUGH THE OUTPUT CAVITY OF A KLYSTRON
L. U. Albers and H. G. Kosmahl 1971 9 p Presented at Intern. Electron Devices Meeting, Washington, D. C., 11-13 Nov. 1971
(NASA-TM-X-67946; E-6614) Avail: NTIS CSCL 09E

The equations of motion used in the computation are discussed along with the space charge fields and the integration process. The following assumptions were used as a basis for the computation: (1) The beam is divided into N axisymmetric discs of equal charge and each disc into R rings of equal charge. (2) The velocity of each disc, its phase with respect to the gap voltage, and its radius at a specified position in the drift tunnel prior to the interaction gap is known from available large signal one dimensional programs. (3) The fringing rf fields are computed from exact analytical expressions derived from the wave equation assuming a known field shape between the tunnel tips at a radius a. (4) The beam is focused by an axisymmetric magnetic field. Both components of B, that is B sub z and B sub r, are taken into account. (5) Since this integration does not start at the cathode but rather further down the stream prior to entering the output cavity it is assumed that each electron moved along a laminar path from the cathode to the start of integration. Author

N72-13202*# Washington Univ., St. Louis, Mo. Dept. of Electrical Engineering.
A CW GUNN DIODE BISTABLE SWITCHING ELEMENT
Marco Hurtado and Fred J. Rosenbaum Nov. 1971 10 p refs
(Grant NGL-26-008-054)
(NASA-CR-124733; Memo-71-12) Avail: NTIS CSCL 09E

A current-controlled bistable switching element using a CW Gunn diode is reported. Switching rates of the order of 10 MHz were obtained with modest circuits. Switching was initiated by current pulses of short duration (5 to 10 nsec). Rise times of the order of several nanoseconds could be obtained. The apparent mechanism which permits the bistable operation of the Gunn diode is the reduction in the mobility of the GaAs active layer due to heating of the device. Author

N72-13203*# International Business Machines Corp., Huntsville, Ala. Electronics Systems Center.
A GUIDE TO ONBOARD CHECKOUT. VOLUME 3: ELECTRICAL POWER
Sep. 1971 83 p

(Contract NAS9-11189)
(NASA-CR-115259; IBM-71W-00310-Vol-3) Avail: NTIS CSCL 09E

The baseline electrical power subsystem for a space station is considered. The subsystem was anlayzed in order to define onboard checkout requirements. Reliability, failure effects, and maintenance are discussed. K.P.D.

N72-13204# Japan Broadcasting Corp., Tokyo. Radio Frequency Engineering and Satellite Broadcasting Research Group.
UNCOOLED PARAMETRIC AMPLIFIER
Yoshihiro Konishi, Katjuaki Uenakada, Kenichi Konno, and Sadayuki Kadoo Dec. 1971 17 p
(NHK-Labs-Note-138) Avail: NTIS

The circuit loss effect in a parametric amplifier which uses a coaxial type cavity on the equivalent noise temperature is discussed. The results of the manufacturing experiment on a 4 GHz coaxal type and a 12 GHz waveguide type uncooled parametric amplifier are also given. Details are given for a 12 GHz simplified parametric receiver developed for use in the satellite broadcast community reception. Author

N72-13205# Japan Broadcasting Corp., Tokyo. Image Devices Research Group.
ENLARGED TARGET IMAGE ORTHICON
Masahiko Takahashi Jan. 1971 9 p
(NHK-Labs-Note-139) Avail: NTIS

An enlarged target image orthicon are developed. The new tube has a 3-inch faceplate and 2-inch neck tube. The diameter of the target was enlarged to 45mm, 1.3 times as large as that of the ordinary target (its diameter is 35.5mm). The target-to-mesh spacing is 25. The new tube has an S/N ratio of 65/72 : 1, whereas the conventional 3-inch tube's ratio averages only 45 : 1. Coils developed to be interchangeable with the coil-tube assembly in the 310 as well as 110 + 3P color camera. The new tube has carefully been designed to suppress picture distortions as well as S distortion in the image section, when the focusing is adjusted into best overall resolution across the picture. This tube also eliminates ghost images. Author

N72-13206*# Boeing Co., Seattle, Wash.
SOLID STATE SWITCH Patent Application
Robert J. Hutto, inventor (to NASA) Filed 21 Oct. 1970 22 p Prepared for JPL
(Contracts NAS7-100; JPL-951934)
(NASA-Case-NPO-10817; US-Patent-Appl-SN-82649) Avail: NTIS CSCL 09A

A mechanically operable solid state switch, suited for use in achieving a variable circuit-switching function in an environment in which bounce and arcing between switch contacts are to be avoided is described. It is characterized by an annular array of photoresponsive switching devices, disposed in communication with an included source of radiation, and a plurality of interchangeable, mechanically operable interrupter disks. Each disk has a predetermined pattern of transparent and opaque portions and is adapted to be interposed in a masking relationship between the source of radiation and the array of photoresponsive devices. An operative displacement of each disk serves to select electrical circuits through the photoresponsive devices of the array in sequences dictated by the pattern of the opaque and transparent portions of the interrupter. NASA

N72-13207*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
DESIGN AND ANALYSIS OF AN AUTOMATIC METHOD OF MEASURING SILICON-CONTROLLED-RECTIFIER HOLDING CURRENT
Edward A. Maslowski Washington Dec. 1971 13 p refs
(NASA-TM-X-2463; E-6578) Avail: NTIS CSCL 09A

The design of an automated SCR holding-current measurement system is described. The circuits used in the measurement system were designed to meet the major requirements of automatic data acquisition, reliability, and repeatability. Performance data are presented and compared with calibration data. The data verified the accuracy of the measurement system. Data taken over a 48-hr period showed that the measurement system operated satisfactorily and met all the design requirements. Author

N72-13208# National Bureau of Standards, Washington, D.C.
TABULATION OF DATA ON SEMICONDUCTOR AMPLIFIERS AND OSCILLATORS AT MICROWAVE FREQUENCIES
Charles P. Marsden Dec. 1971 48 p
(NBS-TN-597) Avail: NTIS

This tabulation includes some of the basic characteristics of semiconductor microwave devices, specifically amplifiers and oscillators of foreign and domestic origin. Author

N72-13209*# Weston Instruments, Inc., College Park, Md. EMR Div.
CRT IMAGE RECORDING EVALUATION Final Report
19 Nov. 1971 157 p
(Contract NAS5-21392)
(NASA-CR-122315) Avail: NTIS CSCL 09E

Performance capabilities and limitations of a fiber optic coupled line scan CRT image recording system were investigated. The test program evaluated the following components: (1). P31 phosphor CRT with EMA faceplate; (2). P31 phosphor CRT with clear clad faceplate; (3). Type 7743 semi-gloss dry process positive print paper; (4). Type 777 flat finish dry process positive print paper; (5). Type 7842 dry process positive film; and (6). Type 1971 semi-gloss wet process positive print paper. Detailed test procedures used in each test are provided along with a description of each test, the test data, and an analysis of the results. Author

N72-13210# Sandia Labs., Albuquerque, N.Mex.
NEUTRON ENERGY DEPENDENCE OF DAMAGE TO SEMICONDUCTOR DEVICES
J. M. McKenzie Jul. 1971 15 p refs
(SC-DC-714161) Avail: NTIS

An experimental neutron standard remote from the resonance region is proposed, and an experimental procedure was developed to compare the damage effectiveness of an unknown spectrum to the standard. A systematic set of experiments on semiconductor devices was developed to provide damage equivalences for the effects of different neutron spectra on various device parameters. A carrier generation lifetime damage constant, a carrier removal damage constant, and a damage constant of an operating majority carrier device were determined for different neutron spectra relative to the damage produced by 14.1 MeV neutrons. NSA

N72-13211# General Electric Co., Philadelphia, Pa. Space Div.
INVESTIGATION OF A LARGE SCALE NONEQUILIBRIUM MAGNETOHYDRODYNAMIC GENERATOR Annual Report, 1 Aug. 1970 - 31 Jul. 1971
Bert Zauderer Aug. 1971 19 p refs
(Contract N00014-70-C-0321; Proj. 9800)
(AD-728407) Avail: NTIS CSCL 10/2

The report presents a summary of the progress during the past year on a continuing investigation aimed at determining the operating characteristics of the linear, non-equilibrium MHD generator. The main effort of the past year was concentrated on reducing the electrode losses in the generator by using heated electrodes which protruded into the gas stream. Using an MHD channel, which was specially constructed for this purpose, large scale electrical power was obtained for the first time in cesium seeded, noble gases at gas stagnation temperatures as low as 2000K. Various electrode structures, both hot and cold, were investigated; but the electrode design was not as important as the cesium concentration in determining the electrode drops. During the past year, construction of a larger MHD channel and of a considerably more powerful MHD magnet and power supply were nearly completed. Author (GRA)

N72-13212# Lincoln Lab., Mass. Inst. of Tech., Lexington.
STABILITY OF TWO-DIMENSIONAL RECURSIVE FILTERS
Thomas S. Huang 2 Jun. 1971 27 p refs
(Contract F19628-70-C-0230; AF Proj. 649L)
(AD-728213; TN-1971-20; ESD-TR-71-150) Avail: NTIS CSCL 09/5

The paper discusses some aspects of the stability problem in two-dimensional recursive filtering. In particular, the author derives a simplified version of a stability theorem due to Shanks and shows that it is equivalent to some results of Ansell. The paper also gives several examples of stability tests and poses a few unsolved problems. Author (GRA)

N72-13213# General Electric Co., Syracuse, N.Y. Heavy Military Electronic Systems.
LOW VOLUME HIGH POWER RADIATING TRANSMITTER Final Technical Report
Gordon F. Stuart and George F. Farrell, Jr. Griffiss AFB, N. Y. RADC Jul. 1971 53 p
(Contract F30602-70-C-0141; Job Order 55730000)
(AD-728639; RADC-TR-71-138) Avail: NTIS CSCL 09/5

Conventional antenna arrays utilize element spacings of approximately one-half wavelength and are configured to minimize mutual coupling effects. The radiating impedance of conventional array elements is predominately the self-impedance of the element. In this program a distributed transmitter feeding a dense array of elements was developed and demonstrated at UHF. The transmitter consists of a total of two hundred fifty-six radiating elements within a one-square wavelength area. Each element is driven by a one-watt amplifier. In the densely packed array mutual coupling effects are used to advantage. The self-impedance of an isolated small element is impractical to drive. In the array environment the radiation resistance is increased through mutual effects to a magnitude suitable for efficient excitation from conventional solid-state amplifiers. This program demonstrated the feasibility of achieving (1) reasonable radiation impedance with small closely-spaced elements, and (2) efficient and coherent power addition in space of energy radiated from a large number of densely-spaced elements. Author (GRA)

N72-13214# Control Data Corp., Minneapolis, Minn. Research Div.
LARGE SCREEN PLASMA DISPLAY Final Technical Report, 18 Mar. 1970 - 16 Apr. 1971
Clark Bergman, Robert W. Johnson, Richard A. Strom, and Thomas N. Thompson Jul. 1971 107 p refs
(Contract F30602-70-C-0154)
(AD-728623; RADC-TR-71-133) Avail: NTIS CSCL 09/5

A program to determine the feasibility and practicality of applying capacitively-coupled plasma display technology to large-screen group displays is described. The display screen would be composed of modules. A 2 in. x 51 in. prototype module was designed and constructed. In the design, a multitude of rectangular glass tubes, running the full module length, are laminated to base electrodes. Upper electrodes are bonded to the array of tubes. Tubes are connected into a common manifold. Uniform electrical characteristics are observed, even at the edges of the module. A 20 x 20 matrix tester was constructed. Author (GRA)

N72-13215# Army Electronics Command, Fort Monmouth, N.J.
SCANNABLE COLD-CATHODE STUDY
Dietrich Dobischek Jun. 1971 54 p refs
(DA Proj. 1H6-62705-A-055)
(AD-728145; ECOM-3428) Avail: NTIS CSCL 09/1

The feasibility of using micron-size field-emission cathodes in combination with a phosphor screen for the construction of a scannable display device is explored. The results demonstrated the feasibility of drawing field emission from asperities grown on Mo by the Al treatment, with sufficient emission obtained to excite a phosphor screen to appreciable brightness. Incorporation of the field-emission type of cathode into an operational display device requires additional engineering development to achieve reasonable life and cathode stability. Author (GRA)

N72-13216# Naval Postgraduate School, Monterey, Calif.
NUMERICAL SYNTHESIS OF IMPULSE RESPONSE FROM FREQUENCY DOMAIN CHARACTERISTICS M.S. Thesis
George Patrick Marshall Jun. 1971 87 p refs
(AD-728699) Avail: NTIS CSCL 09/5

A direct procedure for obtaining the discrete time impulse response of a filter from a sampled approximation of its frequency domain characteristics is presented. The resulting impulse response is given as the summation of a finite number of cosine terms of different frequencies over a fixed interval of time T, and zero elsewhere. The technique is generalized to those cases where the impulse response, over an interval of T, is approximated by the inverse Fourier transform of a set of continuous functions in the frequency domain, called generalized describing functions. These describing functions must satisfy the Dirichlet conditions. They are identical in shape and each is shifted by a finite frequency interval so that their sum approximates the given characteristic of the filter. Author (GRA)

N72-13217# Hewlett-Packard Co., Palo Alto, Calif.
HIGH EFFICIENCY X AND Ku BAND GUNN DEVICES: EMITTER-CONTROLLED NEGATIVE RESISTANCE TRIODE Final Report, 16 Mar. 1970 - 16 Mar. 1971
J. Vilms and N. Moll Ft. Monmouth, N. J. ECOM Aug. 1971 64 p refs
(Contract DAAB07-70-C-0175; DA Proj. 1H6-62705-A-056-04-54)
(AD-728840; ECOM-0175-F) Avail: NTIS CSCL 09/1

Experimental verification at X-band frequencies of the operating principle of the GaAs emitter controlled negative resistance triode (ECNRT), a new microwave source, is presented. Such devices are fabricated in the form of liquid epitaxially-grown, etched-mesa, interdigitated transistor structures having 10 micrometers wide emitter stripes. The DC electrical properties are analyzed. Values of h sub Fe lie in the range 2-100 and are limited by a nondiffusive current component in the emitter-base junction. The main causes of nonuniformity of the injected electron density in the collector region are analyzed: these are emitter current crowding, debiasing along emitter fingers, electron spreading in the base, and electron spreading in the collector. Emitter crowding and electron spreading in the base are significant but are not judged to affect operation adversely. Author (GRA)

N72-13218# International Business Machines Corp., Hopewell Junction, N.Y. East Fishkill Lab.
MATHEMATICAL SIMULATION OF THE EFFECTS OF IONIZING RADIATION ON SEMICONDUCTORS
David P. Kennedy Apr. 1971 110 p refs
(Contract F19628-70-C-0098; AF Proj. 4608)
(AD-728710; AFCRL-71-0272; SR-1) Avail: NTIS CSCL 09/1

The report outlines results of mathematical investigations on the function field-effect transistor and the insulated gate field-effect transistor. A status report is presented on a newly developed numerical technique for solving the ambipolar diffusion equations for holes and electrons in semiconductor material. In two spatial dimensions, calculations performed establish that a soft or low resistance type of current saturation is observed in JFET structures having a low resistance semiconductor substrate. A significant part of the investigation is directed toward analysis of IGFET devices. Author (GRA)

N72-13219# Harry Diamond Labs., Washington, D.C.
BROADBAND DIODE PHASE SHIFTERS
Robert V. Garver Aug. 1971 30 p
(DA Proj.1B262301A300; HDL Proj. CMT15)
(AD-729302; HDL-TR-1562) Avail: NTIS CSCL 09/5

Design figures are presented for four types of diode phase shifters: switched-line, reflection, loaded line, and a new type

using lumped-element high-pass and low-pass circuits. Comparison of their bandwidths shows that most of them can work over an octave bandwidth. Author (GRA)

N72-13395*# Boeing Co., Seattle, Wash. Aerospace Systems Div.
ROTARY RELAY FOR SPACE POWER TRANSFER
H. Theron Haynie *In* NASA. Goddard Space Flight Center 5th Aerospace Mech. Symp. 1971 p 25-31 (See N72-13391 04-15)
Avail: NTIS CSCL 09E

N72-13149# AEG-Telefunken, Backnang (West Germany).
THE 10 A SWITCHING TRANSISTOR [10 A-SCHALTTRANSISTOR]
In its Commun. Satellite Proj. Jul. 1971 p 8-30 refs In GERMAN (See N72-13148 04-07)
Avail: NTIS; ZLDI Munich: 36,60 DM

N72-13150# AEG-Telefunken, Backnang (West Germany).
HIGH VOLTAGE SWITCHING DIODE [HOCHSPANNUNGS-SCHALTDIODE]
In its Commun. Satellite Proj. Jul. 1971 p 31-64 refs In GERMAN (See N72-13148 04-07)
Avail: NTIS; ZLDI Munich: 36,60 DM

N72-13151# AEG-Telefunken, Backnang (West Germany).
MODULATION DIODE [MODULATIONSDIODE]
In its Commun. Satellite Proj. Jul. 1971 p 65-119 refs In GERMAN (See N72-13148 04-07)
Avail: NTIS; ZLDI Munich: 36,60 DM

N72-13152# AEG-Telefunken, Backnang (West Germany).
FREQUENCY CONVERTERS [FREQUENZUMSETZER]
In its Commun. Satellite Proj. Jul. 1971 p 120-174 refs In GERMAN; ENGLUSH summary (See N72-13148 04-07)
Avail: NTIS; ZLDI Munich: 36,60 DM

10 ELECTRONICS

Includes circuit theory; and feedback and control theory. For applications see: 09 Electronic Equipment. For related information see specific Physics categories.

N72-13220*# Massachusetts Inst. of Tech., Cambridge. Electronic Systems Lab.
OPTIMAL CONTROL THEORY FOR NON-SCALAR-VALUED PERFORMANCE CRITERIA Ph.D. Thesis
Hans P. Gerring Sep. 1971 142 p refs
(Grants NGL-22-009-124; AF-AFOSR-1724-69; AF-AFOSR-1941-70; MIT DSR Proj. 72486; MIT DSR Proj. 76265)
(NASA-CR-124769; ESL-R-455) Avail: NTIS CSCL 09C

The theory of optimal control for nonscalar-valued performance criteria is discussed. In the space, where the performance criterion attains its value, the relations better than, worse than, not better than, and not worse than are defined by a partial order relation. The notion of optimality splits up into superiority and non-inferiority, because worse than is not the complement of better than, in general. A superior solution is better than every other solution. A noninferior solution is not worse than any other solution. Noninferior solutions have been investigated particularly for vector-valued performance criteria. Superior solutions for non-scalar-valued performance criteria attaining their values in abstract partially ordered spaces are emphasized. The main result is the infimum principle which constitutes necessary conditions for a control to be a superior solution to an optimal control problem. Author

N72-13221# Naukova Dumka, Kiev (USSR).
MAGNETIC SYSTEMS TECHNOLOGY IN AUTOMATION AND CYBERNETICS: BASES FOR THE CONSTRUCTION OF LOGIC AND DECISION MAKING SYSTEMS
I. S. Yeremeyev and V. S. Podlipenskiy 1970 408 p refs In RUSSIAN
Avail: NTIS HC $6.00/MF $0.95

The synthesis of analog and numerical control systems is discussed. Decision making is also considered. Present and proposed model systems using magnetic elements, and the construction of such systems, was investigated, as well as magnetic analog and analog-numeric equipment for logic circuits. The physical phenomena and processes which take place in magnetic cores, the acting principles of certain noncontact elements, and the means for accomplishing arithmetic and logic operations are presented. Transl. by K.P.D.

N72-13222*# Illinois Univ., Urbana. Coordinated Science Lab.
ELECTRON INTERACTIONS WITH LOCAL AND RESONANT MODE PHONONS IN METAL INSULATOR SEMICONDUCTOR TUNNEL JUNCTIONS Ph.D. Thesis
Lawrence Brian Schein Oct. 1970 127 p refs Sponsored in part by NASA Prepared for JPL
(Contracts DAAB07-67-C-0199; JPL-952383)
(NASA-CR-124714; AD-714295; UILU-ENG-70-240; R-495)
Avail: NTIS CSCL 20B

Interactions between tunneling electrons and phonons associated with nitrogen in n-type silicon carbide and phosphorous, carbon, oxygen, and carbon-oxygen in n-type silicon are reported. The data on silicon carbide tunnel junctions suggest that the interaction with the tunneling electrons arise from nitrogen substituted for silicon atoms and that there is one, or at most two, conduction band minima. Well-known diffusion techniques were used to produce silicon with a high concentration of both boron and phosphorous impurities. Data from tunnel junctions fabricated on these materials indicate that the tunneling electrons participating in the mass defect phonon interaction do not interact in the barrier region of the semiconductor. The interaction between the electron and the mass defect phonons depend on the concentration of impure atoms. The negative bias longitudinal optical phonon lineshape observed in the phosphorous diffused material that remained p-type indicates that this interaction depends on the majority carrier concentration. Since the majority carrier concentration is a bulk property, it can be concluded that this interaction also does not occur in the barrier region of the semiconductor. Author

N72-13223# Technische Univ., Berlin (West Germany).
ON THE OBSERVATION OF SYSTEMS WITH ANALYTICAL NONLINEARITIES Ph.D. Thesis
Uwe Schoenwandt 1970 95 p refs In GERMAN
Avail: NTIS

The general character of the nonlinear filter problem in connection with digital computers is theoretically described. The concept of observability is applied to differential equations with analytical functions and their relationships to identification in adaptive control systems. Transl. by G.G.

N72-13224*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SILICON-CONTROLLED-RECTIFIER SQUARE-WAVE INVERTER WITH PROTECTION AGAINST COMMUTATION FAILURE
Arthur G. Birchenough Washington Dec. 1971 22 p refs
(NASA-TM-X-2442; E-6528) Avail: NTIS CSCL 10B

The square-wave SCR inverter that was designed, built, and tested includes a circuit to turn off the inverter in case of commutation failure. The basic power stage is a complementary impulse-commutated parallel inverter consisting of only six components. The 400-watt breadboard was tested while operating at + or - 28 volts, and it had a peak efficiency of 95.5 percent at 60 hertz and 91.7 percent at 400 hertz. The voltage

regulation for a fixed input was 3 percent at 60 hertz. An analysis of the operation and design information is included.
Author

N72-13225*# Stanford Univ., Calif.
A RESEARCH ON INTEGRATED-CIRCUIT SENSORS FOR GAS CHROMATOGRAPHY Final Report
22 Nov. 1971 13 p
(Contract NAS2-6491)
(NASA-CR-114394) Avail: NTIS CSCL 14B

Fabrication of a miniature gas chromatograph column using integrated cirkuit technology was studied and found to be feasible. A bonding problem of forming a strong, gas tight seal between two wafers of silicon has prevented the completion of the column design. Continuing research using tin or a chromium-gold bond promises to overcome the problems of using the proposed gold-eutectic bond. Specifications for the miniature gas chromatograph column are: a spiral capillary column of semi-circular cross section, 30 micron radius, and a total length of 6.9 meters etched into a silicon structure 50 mm in diameter and 0.625 mm thick. Author

N72-13226# Sandia Corp., Albuquerque, N.Mex.
EXPOSED TWO-WIRE TRANSMISSION LINE ELECTROMAGNETICALLY COUPLED TO A ROCKET
Charles W. Harrison, Jr. and Ronold W. P. King (Harvard Univ., Cambridge, Mass.) Feb. 1971 18 p refs Supersedes SC-R-71-3185 Sponsored by AEC
(SC-R-71-3258; SC-R-71-3185) Avail: NTIS

The response of impedance-loaded conductors, electromagnetically coupled to a rocket, when illuminated by a plane wave is examined. The currents in the load impedances are induced by the action on the line of both the incident field and the scattered field from the rocket. A coupled circuit consisting of a two wire transmission line near a rocket is considered. The objective is to derive formulas for the currents in the impedances terminating the line when the rocket, line, and incident field are oriented in space to maximize the response in the line. Author

N72-13227# Sandia Labs., Albuquerque, N.Mex.
NEUTRON-PRODUCED TRAPPING CENTERS IN JUNCTION FIELD-EFFECT TRANSISTORS
B. L. Gregory, S. S. Naik (Calif. Univ., Berkeley), and W. G. Oldham (Calif. Univ., Berkeley) Jul. 1971 38 p refs Presented at Ann. Conf. on Nucl. and Space Radiation Effects, Durham, N. H., 20 Jul. 1971 Supported by AEC
(SC-DC-713707; Conf-710709-6) Avail: NTIS

The junction field effect transistor has been employed to study trapping centers introduced in silicon by fast neutron irradiation. Extensive measurements have been made of both the static and dynamic characteristics of irradiated devices. The degradation and annealing of (G sub MSAT, I sub DSS and V sub PO) have been explored in both n and p channel devices, as a function of neutron fluence and dopant concentration. The results of isochronal annealing measurements are compared to similar measurements in bulk silicon, and indicate that the parameter annealing above room temperature is dependent on phosphorous concentration in the n-type devices. The trapping center effects on small signal transconductance and large signal pulse response are characterized and the data is utilized to determine ionization energy values for the dominant traps. In n-type, trap energy levels of E sub C - 0.41 and E sub C - 0.49 eV are obtained, and in p-type an energy level of E sub V + 0.32 eV is observed. Author

N72-13228# Sandia Labs., Albuquerque, N.Mex.
DESIGNING ULTRAHARD BIPOLAR TRANSISTORS
C. W. Gwyn and B. L. Gregory [1971] 35 p refs Presented at Ann. Conf. on Nucl. and Space Radiation Effects, Durham, N. H., 20 Jul. 1971 Supported by AEC
(SC-DC-713706; Conf-710709-4) Avail: NTIS

Calculations are presented for a bipolar transistor which indicates the relative importance of the device regions in establishing the neutron tolerance. For conventionally diffused profiles with a fixed set of device parameters, the calculations indicate that an optimum base width may occur which will yield the maximum neutron hardness. The analysis indicates that the neutron hardness can be increased substantially by using a device profile with a shallow, abrupt emitter and a narrow base region. Devices utilizing these criteria are extremely tolerant to neutron irradiation and show a current gain greater than 10 after a neutron influence of 10 to the 16th power n/cm2 (E > 10 keV). This represents an order of magnitude increase in device hardness over those presently available. Author

N72-13229# Addis Translations International, Woodside, Calif.
EFFECT OF SYNCHROTRON-OSCILLATION RESONANCES ON LONGITUDINAL BEAM INSTABILITY IN A STORAGE RING
S. G. Kononenko, L. D. Lobzov, L. V. Reprintsev, and A. M. Shenderovich Feb. 1971 7 p refs Transl. into ENGLISH of Akad. Nauk Ukr. SSR, Fiziko-Tekhnicheskii Inst., Kharov, report, KHFTI-70-46 In ENGLISH and RUSSIAN Prepared for Calif. Univ., Berkeley. Lawrence Radiation Lab.
(UCRL-Trans-1439; KHFTI-70-46) Avail: NTIS

A study of the effects due to simultaneous action of an induced voltage and synchrotron oscillation resonances in a storage ring is presented. Measurements made in the 70-MeV electron storage ring are described, and the results are interpreted theoretically. Author (NSA)

N72-13230# Sandia Labs., Albuquerque, N.Mex.
CIRCUIT APPLICATIONS OF TRANSIENT ANNEALING
H. H. Sander and B. L. Gregory Jul. 1971 19 p refs Presented at Ann. Conf. on Nucl. and Space Radiation Effects, Durham, N. H., 20 Jul. 1971 Sponsored by AEC
(SC-DC-713804; Conf-710709-5) Avail: NTIS

A method is presented for predicting transistor annealing factors from simple electrical measurements on a device. A nomograph has been derived from experimental data which relates annealing factors at any time after exposure to the electron density in the emitter-base space-charge region. The electron density in this region is related to V sub BE in a device by a simple expression, presented graphically. The effects of transient annealing are investigated for two typical circuit situations (power inverter circuits and logic circuits) where devices may be OFF during irradiation and subsequently required to turn-on. The Darlington circuits utilized in typical power-inverters prolong the annealing, if OFF when exposed. The propagation delay of a NAND gate series pair is increased considerably at early times after a neutron exposure. This additional delay can result in reduced pulse width or lost pulses. Author

N72-13231# Sandia Labs., Albuquerque, N.Mex.
NEW PROPAGATION DELAY TIME BRIDGE FOR THE STUDY OF DISPLACEMENT DAMAGE EFFECTS IN BIPOLAR TRANSISTORS
W. H. Sullivan and J. H. Weinlein [1971] 40 p refs Presented at Ann. Conf. on Nucl. and Space Radiation Effects, Durham, N. H., 20 Jul. 1971 Sponsored by AEC
(SC-DC-713695; Conf-710709-2) Avail: NTIS

Bridge circuit for the measurement of junction transistor total propagation delay time is described. The bridge is calibrated in time units, providing a direct readout of delay time. An experiment to evaluate the bridge as a one-test acceptance screening tool in neutron hardness assurance programs is described. Finally, a general discussion of propagation delay time and its interpretation is presented as an appendix. Author (NSA)

11 FACILITIES, RESEARCH AND SUPPORT

Includes airports; lunar and planetary bases including associated vehicles; ground support systems; related logistics; simulators; test facilities (e.g., rocket engine test stands, shock tubes, and wind tunnels); test ranges; and tracking stations.

N72-13232# National Research Council of Canada, Ottawa (Ontario). Div. of Mechanical Engineering.
IMPROVEMENTS TO A SMOKE GENERATOR FOR USE IN WIND TUNNELS
R. W. Bassett and H. S. Fowler Oct. 1971 13 p refs
(MET-514; NRC-12288) Avail: NTIS

In order to overcome disadvantages in existing methods, a new smoke-system for wind tunnels has been investigated. The system consists simply of a device for mixing jets of anhydrous ammonia and sulphur dioxide gases. It is instantly controllable, produces dense white smoke without clogging, is easily portable, and poses no fire risk. Provided simple precautions are taken there is no danger of toxic concentrations building up, and the substances used are non-corrosive, readily available, and cheap. The system has been improved by the design of a large-capacity probe for use in high-speed airstreams. Author

N72-13233*# McDonnell Aircraft Corp., St. Louis, Mo.
AN INVENTORY OF AERONAUTICAL GROUND RESEARCH FACILITIES. VOLUME 2: AIR BREATHING ENGINE TEST FACILITIES
C. J. Pirrello, R. D. Hardin, M. V. Heckart, and K. R. Brown Washington NASA Nov. 1971 127 p
(Contract NAS2-5458)
(NASA-CR-1875) Avail: NTIS CSCL 14B

The inventory covers free jet and direct connect altitude cells, sea level static thrust stands, sea level test cells with ram air, and propulsion wind tunnels. Free jet altitude cells and propulsion wind tunnels are used for evaluation of complete inlet-engine-exhaust nozzle propulsion systems under simulated flight conditions. These facilities are similar in principal of operation and differ primarily in test section concept. The propulsion wind tunnel provides a closed test section and restrains the flow around the test specimen while the free jet is allowed to expand freely. A chamber of large diameter about the free jet is provided in which desired operating pressure levels may be maintained. Sea level test cells with ram air provide controlled, conditioned air directly to the engine face for performance evaluation at low altitude flight conditions. Direct connect altitude cells provide a means of performance evaluation at simulated conditions of Mach number and altitude with air supplied to the flight altitude conditions. Sea level static thrust stands simply provide an instrumented engine mounting for measuring thrust at zero airspeed. While all of these facilities are used for integrated engine testing, a few provide engine component test capability. Author

N72-13234# European Organization for Nuclear Research, Geneva (Switzerland).
NEW MAGNET POWER SUPPLY OF THE CERN PROTON SYNCHROTRON. PART 1: GENERAL DESCRIPTION
O. Bayard 20 Apr. 1971 20 p refs In FRENCH
(Cern-71-10-Pt-1) Avail: AEC Depository Libraries

The history, development, and operation of the new power supply for the 100 magnets of a proton synchrotron are described in general terms. By power supply is meant all the electrical equipment which furnishes to the principal coils of the magnets the ampere turns necessary for the periodic establishment of the magnetic field. NSA

N72-13235# Sandia Labs., Albuquerque, N.Mex.
TRANSIENT AND PERMANENT RADIATION EFFECTS IN GUNN AND IMPATT OSCILLATORS
R. J. Chaffin Jun. 1971 39 p refs
(SC-RR-710378) Avail: NTIS

An experiment designed to observe rate effects in Gunn and IMPATT diodes is described. The irradiations were performed using a pulse reactor which produces rates as high as gamma dot = 4 x 10 to the 8th power rads/sec and N dot = 3 x 10 to the 18th power neutrons/sq cm sec. The Gunn diode was found to be essentially rate-insensitive at these rates. However, large amounts of permanent damage were incurred at relatively low (10 to the 13th power nvt) levels. The IMPATT diodes were found to be rate-sensitive at the test rates, but they recovered shortly after the radiation pulse and showed almost no permanent damage out to levels of 10 to the 15th power nvt. The reasons for the observed differences in the rate sensitivities of the devices tested are discussed. Author (NSA)

N72-13236# Princeton Univ., N.J. Plasma Physics Lab.
RING CATCHERS IN FM-1
J. W. Willard May 1971 10 p refs Presented at 4th Symp. on Eng. Probl. of Fusion Res., Washington, D. C., 20-23 Apr. 1971
(Contract AT(30-1)-1238)
(MATT-843; Conf-710418-20) Avail: NTIS

The system for positioning and arresting the poloidal field coil is described. The ring is held on centerline of the machine by four positioner assemblies. Rotation of the ring to proper azimuth for filling, venting, and charging is provided. The positioner assemblies are lowered to the vacuum vessel floor during ring levitation or for ring maintenance. In the event of a system failure, resulting in loss of ring stabilization, the ring may be arrested by four scissors-type mechanisms positioned in the vacuum vessel. A cylinder-mounted solenoid poppet valve is fired by a capacitor bank resulting in a signal to closure time of 60 msec. A slowmode catch may also be actuated, through externally mounted valves, resulting in a cycle time of 150 to 200 msec. Upon closure and contact with the ring, the ring energy is absorbed by uncoupled slide and tilt spring systems. After a catcher closure cycle, the positioners are again inserted and the ring returned to the proper position. Author (NSA)

N72-13237# Princeton Univ., N.J. Plasma Physics Lab.
MACHINE FOR ADIABATIC TOROIDAL COMPRESSION
U. R. Christensen, J. C. Citrolo, J. G. Murray, and K. E. Wakefield May 1971 7 p refs Presented at 4th Symp. on Eng. Probl. of Fusion Res., Washington, D. C., 20-23 Apr. 1971
(Contract AT(30-1)-1238)
(MATT-847; Conf-710418-16) Avail: NTIS

An adiabatic toroidal compressor is being built to investigate the feasibility of a proposed technique for increasing the density and ion temperature of conventional tokamaks. By applying a suitable magnetic field normal to the plane of a usual Tokamak discharge, the major radius is caused to shrink to about 0.4 of its original value, thereby resulting in an increase both in temperature and density. A description of the device is given. NSA

N72-13238# Kernforschungsanlage, Juelich (West Germany). Inst. fuer Physikalische Chemie.
SHIELDING OF FAST NEUTRONS FROM THE CYCLOTRON FOR MEDICAL BIOLOGICAL RESEARCH
P. F. Sauermann Apr. 1971 26 p refs In GERMAN
(JUL-751-PC) Avail: AEC Depository Libraries

Using the neutron spectrum of the reaction Be-9(d,n)B-10 (thick target), the attenuation factors for determining the shielding for fast neutrons from compact cyclotrons for two directions of emission are presented. Using these factors the necessary shieldings, consisting of different concretes, water or iron, can be evaluated by simple mathematical calculation. This is explained by an example from the field of health physics. Author(NSA)

N72-13239# Sandia Corp., Albuquerque, N.Mex.
NEREUS MARX GENERATOR, A 600 KILOVOLT, 1.5 KILOJOULE UNIT
Raymond S. Clark Mar. 1971 47 p refs Sponsored by AEC
(SC-DR-710216) Avail: NTIS

A 600 kilovolt, 1.5 kilojoule Marx generator was developed for the Nereus program. A detailed description of this generator along with a review of recent low inductance Marx generator technology is given. Author (NSA)

N72-13240# Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Lab. Nazionali di Frascati.
STATUS REPORT ON THE ELECTRON-POSITRON STORAGE RING ADONE
24 Feb. 1971 4 p refs Presented at the Natl. Particle Accelerator Conf., Chicago, 1-3 Mar. 1971
(LNF-71/7; CONF-710308-29) Avail: AEC Depository Libraries

Data on the first year of operation and on recent bunch length and luminosity measurements at the electron-positron 1.5 GeV/beam storage ring Adone are presented. Author (NSA)

N72-13241# European Organization for Nuclear Research, Geneva (Switzerland).
DAMPING OF NON-LINEAR SYNCHROTRON OSCILLATIONS OF TWO BUNCHES IN THE PRESENCE OF BEAM-CAVITY INTERACTION
S. G. Kononenko and A. M. Shenderovich Mar. 1971 6 p refs Transl. into ENGLISH from Atomnaya Energ. (Moscow), v. 28, 1970 p 436-438
(CERN-Trans-71-19) Avail: AEC Depository Libraries

A theoretical study is presented of the synchrotron oscillations of two beams within one separatrix. Their interaction with the cavity is taken into account. NSA

N72-13242# Institute of Nuclear Research, Warsaw (Poland).
PHYSICAL AND GEOMETRICAL PARAMETERS OF ANNA CRITICAL ASSEMBLIES, PART 1
Cyryl Dabrowski and Stefan Malewski 1971 32 p refs
(INR-1288-Pt-1) Avail: AEC Depository Libraries

Several critical ANNA assemblies were analyzed to determine their physical parameters from the calculation of the fine structure flux distributions in the elementary cells and of the slowing-down and resonance effects. These parameters were used to determine critical sizes and neutron density distributions in a two-group diffusion approximation. A comparison of the calculated data with the available experimental results was carried out. Au hor (NSA)

N72-13243# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
INFLUENCE OF THE MAGNETIC FIELD ON THE SPARK CHAMBER EFFICIENCY
K. G. Nekrasov 1971 11 p refs In RUSSIAN
(JINR-P13-5811) Avail: AEC Depository Libraries

More precise value of the criterion for the formation of the spark clamp in neon is obtained on the basis of the shower-streamer theory of discharge. It is shown that the maximum resolution time of spark chambers depends on the zone dimensions necessary for the discharge development. The influence of the magnetic field on the parameters determining the spark chamber efficiency is considered. Author (NSA)

N72-13244# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
TIME PROPERTIES OF A SPARK CHAMBER FILLED WITH HELIUM AND HELIUM-HYDROGEN MIXTURE
O. A. Zaimidorogo, Yu. I. Ivanshin, and L. P. Chernenko 1971 13 p refs In RUSSIAN
(JINR-P13-5828) Avail: AEC Depository Libraries

The time characteristics and efficiency of a spark chamber filled with helium and helium-hydrogen mixtures were determined. It is shown that the mechanism of remembrance of the charged particle tracks acts in helium due to the transition of atoms to metastable levels. Author (NSA)

N72-13245# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Serpukhov (USSR). Inst. Fiziki Vysokikh Energii.
CALCULATION AND THE MODEL INVESTIGATION OF THE STRESSED STATE OF THE BUBBLE CHAMBER BODY SKAT
V. N. Odintsov, O. V. Semenov, Yu. V. Spirchenko, E. P. Kuznetsov, and V. I. Snyatkov 1970 13 p refs In RUSSIAN
(IFVE-SPK-70-9) Avail: AEC Depository Libraries

The calculation methodics of the bubble chamber body, SKAT with a thick wall is given. The results of the body stressed state made of aluminum alloy to a scale 1:10 are presented. The measurement results and calculated data for the most stressed section are compared. Author (NSA)

N72-13246# Peat, Marwick, Mitchell and Co., Boston, Mass.
INTERCITY TRANSPORTATION EFFECTIVENESS MODEL Final Report
William A. Jessiman and Donald E. Ward Dec. 1970 121 p refs For Tech. Suppl. see PB-200470
(Contract DOT-T8-542)
(PB-200469; T8-542-1) Avail: NTIS CSCL 01B

The intercity transportation effectiveness model approximates the mix of aircraft, routes, schedules, and terminal facilities that satisfy intercity air-carrier passenger and cargo demand at minimum social time and economic cost. The model comprises a set of integrated computer modules including: a passenger and cargo demand module, a route module, a network assignment module, and a timetable building module. The daily traffic assignment model is a decomposed linear program in which a method is used to solve the subproblem in greatly reduced running time. The model is useful in solving problems involving such issues as airline mergers, route awards, new terminals, traffic congestions and new aircraft technology. It was applied successfully to real-world airline networks. Author (GRA)

N72-13247# Naval Undersea Research and Development Center, San Diego, Calif.
NUC SONAR TRANSDUCER CALIBRATION FACILITIES Research and Development Report, Nov. - Dec. 1970
Charles E. Green Jul. 1971 32 p refs
(AD-728038; NUC-TP-232) Avail: NTIS CSCL 14/2

The two main sonar transducer calibration stations presently operated by the Naval Undersea Research and Development Center, San Diego, are described. The acoustical environment, mechanical handling facilities, electronic equipment, high pressure calibration facilities, and reference transducers available at each station are described in detail. Procedures for test scheduling and data analysis are described. Author (GRA)

N72-13248# Army Electronics Command, Fort Monmouth, N.J.
APPARATUS FOR A CONTINUOUS PROCESS IN PREPARATION OF DISTILLED WATER
John A. Christopulos Jun. 1971 15 p refs
(DA Proj. 1T0-61102-A-34-A)
(AD-728100; ECOM-3430) Avail: NTIS CSCL 14/2

An all glass still which provides 250-400 cc per hour of water of 0.066 x 0.000001/ohm/cm specific conductance (25C) is described. The apparatus allows for continuous production of distilled water, and has provisions for checking the quality without exposing the distillate to the atmosphere. Author (GRA)

N72-13249# Naval Postgraduate School, Monterey, Calif.
PERFORMANCE ANALYSIS OF A TURBO-TYPE ENERGY ABSORBER FOR AN AIRCRAFT CARRIER ARRESTING GEAR M.S. Thesis
Leo Stanley Rolek, Jr. Jun. 1971 132 p refs
(AD-728682) Avail: NTIS CSCL 13/9

The increasing weight and speed of carrier based aircraft are taxing the limit of conventional piston type energy absorbers which are used for arresting gear. Turbo-type absorbers have been proposed as an alternative. This study investigates a turbo-type energy absorber for an aircraft arresting gear under development by the Naval Air Engineering Center. A mathematical analysis, computer simulation and performance prediction are given for each mode of operation. It was initially expected that the absorber could operate in just two modes, forward and reverse, but the analysis shows that four distinct modes are possible, since not only shaft rotation but the path of fluid flow kan be reversed. Theoretical performance predictions are also compared with test data from an existing smaller scale version of the absorber. The agreement is excellent. An approximation of scaling effects on power absorption is also presented. It is concluded that the turbo-type absorber is basically adequate to meet the demands of carrier operation for the forseeable future.
Author (GRA)

N72-13250# Technion - Israel Inst. of Tech., Haifa. Dept. of Aeronautical Engineering.
CALIBRATION OF THE TAILORED INTERFACE 8 INCHES X 10 INCHES SHOCK TUNNEL, PART 2 Final Scientific Report
A. Kuritzky and J. Rom Feb. 1971 87 p refs
(Contract F61052-70-C-0005; AF Proj. 7063)
(AD-728734; TAE-116-PT-2; FR-2; Rept-61102F; Rept-681307) Avail: NTIS CSCL 14/2

The work presents the design considerations and the calibration of a shock tunnel for aerodynamic measurements at hypersonic Mach numbers. The shock tunnel is composed of a shock tube which is used for the production of high temperature and high pressure air reservoir, which is then expanded through a supersonic nozzle, thereby attaining high Mach number flow in the test section. In order to obtain maximum test time a 'tailored' mode of operation is used for this shock tunnel. A method for calculating the optimum ratio of the compression Chamber length to the low pressure tube length for a given total shock tube length that will result in a maximum test duration is presented. The flow in the test section is calibrated using a total pressure rake and by static pressure measurements and measurements of stagnation point heat transfer rates at various points in the test section. The flow conditions are then calculated using the theoretical relations for stagnation point heat transfer rates. The experimental results show the flow in the horizontal plane with a relatively thin boundary layer.
Author (GRA)

N72-13251# New York Univ., N.Y. Aerospace Lab.
A HIGH REYNOLDS NUMBER FACILITY FOR OPERATION AT 10,000 PSI AND 3500 R Final Scientific Report, 15 Dec. 1968 - 14 Dec. 1970
Victor Zakkay and Daniel M. Speyer May 1971 116 p refs
(Contract F33615-69-C-1365; AF Proj. 7065)
(AD-729201; ARL-71-0084) Avail: NTIS CSCL 13/1

The design of a cored brick air heater, moderately high density aluminum oxide possessing a porosity of approximately 30% to operate at a pressure of 10,000 psi, has been completed. The heater supplies 50 lb/sec of air at discharge temperature greater than 3500 degrees R, with a maximum temperature variation of 100 R over a 15 sec running time. Various types of heater vessel construction were considered before the final selection of a forged vessel was made (all vertical configurations). Press closures have been utilized to permit rapid heater operation and coolant passages have been placed along the full length of the heater core. The passages contribute to a reduced insulation thickness (5 inches versus 10 inches to a foot or more in existing units) and provide an initial preheat to the incoming air during the heater blowdown, thereby effecting a reduction in heater length as well as avoiding the use of alumina at very low temperatures where brittleness is extreme. This novel design results in a savings of roughly 40% as regards the pressure vessel size, and the total cost of the heater is reduced by a similar amount. Author (GRA)

N72-13252# Human Factors Research, Inc., Goleta, Calif.
DESIGN CHARACTERISTICS OF A DIGITAL SONAR MAINTENANCE TRAINER: AN ADJUNCT TO DEVICE 14E22 Final Report, 1969-1970
John F. Depauli Orlando, Fla. Naval Training Device Center Jun. 1971 54 p refs
(Contract N61339-69-C-0268; NAVTRADEVCEN Proj. 7911-3)
(AD-729029; HER-TR-1701; NAVTRADEVCEN-69-C-0268-1) Avail: NTIS CSCL 05/9

The objective of this study was to determine the design characteristics of an advanced sonar unit to be used as an adjunct to Device 14E22 (the Generalized Sonar Maintenance Trainer). To accomplish this objective, a study was made of the functional and design characteristics of recently developed sonar systems, sonar design trends, and the state-of-the-art in general electronics. It was concluded that new technology sonars such as the SQQ-23 and SQS-26 series equipments differ significantly from older systems in that they represent the advent of a new era in sonar design, that of the solid state digital sonar. It was also concluded that an advanced Digital Sonar Maintenance Trainer was needed as an adjunct to Device 14E22 and that such a device would be a valuable asset to sonar school instructors. The report describes the recommended design characteristics of a Digital Sonar Maintenance Trainer (DSMT). It is recommended that an experimental model of the device be constructed and evaluated. Author (GRA)

12 FLUID MECHANICS

Includes boundary-layer flow; compressible flow; gas dynamics; hydrodynamics; and turbulence. For related information see also: 01 Aerodynamics; and 33 Thermodynamics and Combustion.

N72-13253 National Lending Library for Science and Technology, Boston Spa (England).
THE HYDRAULIC RESISTANCE OF ANNULAR AND DISPERSED ANNULAR MODES OF FLOW OF A TWO PHASE MIXTURE
V. V. Permyakov and A. M. Podsushnyi 23 Jun. 1971 6 p refs Transl. into ENGLISH from Inzh.-Fiz. Zh. (USSR), v. 18, no. 3, Mar. 1970 p 409-413
(NLL-WH-307-(9091.9F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

Results are presented for an experimental study of the hydraulic resistance of annular flow, applied to various heat exchange equipment. Author

N72-13254 National Lending Library for Science and Technology, Boston Spa (England).
PRESENTATION AND SOLUTION OF THE INTERNAL PROBLEM OF THE BOUNDARY LAYER THEORY
A. Sh. Dorfman Oct. 1971 10 p refs Transl. into ENGLISH from Teplofiz. Teplotekh. (Kiev), v. 17, 1970 p 80-86
(NLL-RTS-6715) Avail: Natl. Lending Library, Boston Spa, Engl.: £1.00; 3 NLL photocopy coupons

A solution for the two boundary layer equations obtained by suitable modification of the Navier-Stokes equation in the case of the internal channel flow problem is developed by a method in which single or multiparametric functions are used for linearization; these functions are generally used in integral calculations. This method enables the nonlinear terms of the initial equation to be considerably better approximated. G.G.

N72-13255 National Lending Library for Science and Technology, Boston Spa (England).
CALCULATION OF FLUID CIRCUITS, PART 2
R. Ducousset 5 Mar. 1971 10 p ref Transl. into ENGLISH from Mes. Regul. Automat. (Paris), v. 35, no. 10, Oct. 1970 p 109-114

(NLL-M-20907-(5828.4F); NLL-1390/71/BD; NLL-T1240/MRS/71) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

The various technical methods used to calculate fluid circuits are given. Methods include diaphragms, bellows, and proportional fluid modules. The rules governing the calculations, examples of each solution, and applications of each solution are given. E.H.W.

N72-13256 National Lending Library for Science and Technology, Boston Spa (England).

CALCULATION OF FLUID CIRCUITS

R. Ducousset [1971] 31 p Transl. into ENGLISH from Mesures (Paris), Aug. - Sep. 1971 p 92-104

(NLL-M-20852-(5828.4F); NLL-T1106/MRS/71) Avail: Natl. Lending Library, Boston Spa, Engl.: 3 NLL photocopy coupons

The application of electrical circuit calculations to pneumatic and hydraulic circuits calculations is discussed. It is recognized that conditions must be met in which the flow is stable and laminar in order to apply electrical calculation methods. The justification of the rules for calculating fluid circuits in both simple and extended forms is presented. The rules for calculations are applied to different examples from practice. Author

N72-13257 National Lending Library for Science and Technology, Boston Spa (England).

CORRELATION MEASUREMENTS ON GAS FLOWS BY MEANS OF LASER BEAM

H. D. VomStein, H. J. Pfeifer, and B. Koch 22 Sep. 1971 5 p refs Transl. into ENGLISH from Z. Angew. Phys. (W. Berlin), v. 30, no. 2-3, 1970 p 174-176

(NLL-NEL-TT-2264-(6075.461)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

An optical method is described, which, together with correlation analysis, enables information to be obtained on the speed and coherence length of phase objects and on their speed distribution. The performance of this method is demonstrated for the study of shock waves and of flames. Author

N72-13258*# Wintec Corp., Los Angeles, Calif.

ETCHED LABYRINTH DISC FILTER ASSEMBLY: 2 MICRON, 5 MICRON, 10 MICRON, 20 MICRON, 40 MICRON Development Test Report

Oct. 1971 13 p Sponsored in part by NASA Prepared for JPL (Contract JPL-AQ-552110)

(NASA-CR-124813; TR-254) Avail: NTIS CSCL 20D

A series of development tests was conducted to determine the physical and performance characteristics of the stacked etched labyrinth disc filter assembly. The configuration of the hardware used, test methods and systems, the test conducted and the resultant test data are described. Areas of discussion include: bubble point (micron calibration), compressive loading, torque sensitivity, fluid flow characteristics, and fabrication problems. A bubble point - micron jating conversion factor for etched discs of the tested configuration was successfully developed. Very close correlation between 10, 20, and 40 micron discs was obtained. The conversion factor is 234. when Isopropanol is used and the bubble point data are corrected to the surface tension of the fluid used. Author

N72-13259# Kyoto Univ. (Japan). Dept. of Aeronautical Engineering.

NONEQUILIBRIUM STAGNATION POINT BOUNDARY LAYER OF A PARTIALLY IONIZED GAS

K. Matsuoka (Nara Tech. Coll.) and M. Nishida May 1971 24 p refs

(CP-30) Avail: NTIS

The electron temperature profile across the stagnation point boundary layer and the inviscid layer is described for the case in which electrons are not in thermal equilibrium with atoms and ions in a free stream. The wall boundary conditions for the electron temperature and the concentration of electron-ion pairs are determined from the conditions for the continuous electron energy flux and ion mass flux through the outer edge of an ion sheath, with zero net current at the wall. Considering the boundary layer and the shock at the same time, the profile of electron temperature was obtained from the free stream to the wall. Author

N72-13260*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.

TWO PHASE FLOW SYSTEM WITH DISCRETE IMPINGING TWO-PHASE JETS Patent Application

David G. Elliott and Lance G. Hays, inventors (to NASA) Filed 21 Oct. 1970 10 p

(Contract NAS7-100)

(NASA-Case-NPO-11556; US-Patent-Appl-SN-82648) Avail: NTIS CSCL 20D

A flow system with discrete two-phase nozzles is disclosed. It provides an efficient and simple system for separating gas from liquid in a two-phase flow system. The two-phase jets produced in the nozzles are made to impinge on one another in a mixing channel, resulting in significant coalescence of the liquid into a stream in the center of the channel. The gas in the jets is thereby forced to the periphery of the liquid stream. NASA

N72-13261# Michigan Univ., Ann Arbor. Cavitation and Multiphase Flow Lab.

SONOLUMINESCENCE FROM ACOUSTICALLY CAVITATED WATER

R. B. Stephenson Nov. 1971 29 p refs

(UMICH-01357-20-T) Avail: NTIS

An experimental investigation was launched into the effects of fast neutron radiation on the inception of nucleate boiling utilizing acoustically induced cavitation techniques. An attempt was made to use the thermally induced light flashes (sonoluminescence) of bubble collapse as a detection method. Data was obtained about cavitation inception and bubble collapse distributions in a non-radiation environment. Work to obtain more definitive data and similar data in a fast neutron environment is continuing. Author

N72-13262*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

ROTATIONAL TEMPERATURE DETERMINATION IN FLOWING NITROGEN USING AN ELECTRON BEAM

D. C. Lillicrap and Louise P. Lee Washington Dec. 1971 32 p refs

(NASA-TN-D-6576; L-8011) Avail: NTIS CSCL 20D

The measurement of rotational temperature by the electron-beam fluorescence technique is investigated for temperatures between 78 K and 300 K by using the 0-0 band of the nitrogen first negative system. Existing methods for calculating the rotational temperature from electron-beam spectra result in values which are higher than the true temperature and the error increases with density and electron-beam current. The errors are believed to arise through neglect of the effects of secondary electrons. Excitation by low-energy secondary electrons can increase the population of the sparsely populated rotational ground states at the expense of the abundantly populated states. This secondary excitation is proposed as the cause of the error in the calculated rotational temperature and a theoretical study determines that the density and beam current govern the excitation rate. Rotational-temperature measurements are made in a flowing stream of nitrogen at a known temperature for a range of densities and beam currents. Author

N72-13263# McGill Univ., Montreal (Quebec). Mechanical Engineering Research Labs.

A PRELIMINARY EXPERIMENTAL INVESTIGATION OF THE STRUCTURE OF A TURBULENT TRAILING VORTEX

E. D. Poppleton Mar. 1971 83 p refs

(Grant DRB-G-9551-12)

(TN-71-1) Avail: NTIS

Measurements have been made of the distribution of the Reynolds stresses, and of the mean velocity in a turbulent trailing vortex. The pressure distribution was also measured. The effect of injecting air into the vortex core has also been investigated and it was found that the decay of the vortex can be accelerated considerably by this means. Author

N72-13264# Cambridge Univ. (England). Dept. of Engineering.
THE UNIQUENESS OF TURBOMACHINERY FLOW CALCULATIONS
H. Marsh Feb. 1971 13 p refs
(CUED/A-Turbo/TR-24) Avail: NTIS

When calculating the flow through turbomachines, it is assumed that on each cycle of iteration, there is only one solution for the flow pattern. The uniqueness of the solution obtained by the method of streamline curvature is examined and a set of Mach number conditions are derived which are sufficient to ensure that the flow pattern is unique. The Mach number limitations are the same as those which are necessary to avoid ambiguity in the matrix through-flow analysis. An alternative procedure is then described in which the solution for the flow pattern is always unique. Author

N72-13265# Cambridge Univ. (England). Dept. of Engineering.
FLOW MODELS FOR TURBOMACHINES
J. H. Horlock and H. Marsh 1971 36 p refs
(CUED/A-Turbo/TR-25) Avail: NTIS

The equations for the flow through cascades of blades are averaged across the pitch and then compared with those for the flow through hypothetical models of blade rows - a closely spaced blade row, an axisymmetric flow with body forces and the flow on a mean stream surface. It is shown that these models can provide an accurate representation for the overall flow changes across a blade row, but they cannot give an exact local matching with the averaged properties of the flow in the real cascade. The nature of the blade forces in the real flow and the body forces in the hypothetical flow is discussed. Author

N72-13266# Cambridge Univ. (England). Dept. of Engineering.
EFFECTS OF FREE STREAM TURBULENCE ON BLADE PERFORMANCE IN A COMPRESSOR CASCADE
B. J. Evans 1971 48 p refs
(CUED/A-Turbo/TR-26) Avail: NTIS

Boundary layer behavior on the stator blades of an axial flow compressor were studied under the effects of free stream turbulence generated by the passage of upstream rotor blades across the flow field, at low Reynolds' numbers. These conditions were simulated in a specially designed two-dimensional linear cascade. A detailed study of the boundary layer behavior was made up to turbulence levels of 4% using flow visualization and hot wire anemometry techniques. Reliable data on separation bubble length and on natural attached transition length and position is presented in a directly applicable form, and the necessity of considering the turbulence structure is demonstrated by an experimental investigation into the isolated effects of scale upon transition. Author

N72-13267# Cambridge Univ (England). Dept. of Engineering.
CROSS-FLOWS IN BOUNDED THREE DIMENSIONAL TURBULENT BOUNDARY LAYERS
J. H. Horlock 1971 42 p refs
(CUED/A-Turbo/TR-28) Avail: NTIS

A study is made of the flow normal to the mainstream direction (cross-flow) that takes place in three-dimensional bounded turbulent boundary layers near a wall, i.e. boundary layers restricted by the presence of bounding surfaces normal to that wall. Such boundary layers are present in the flow through rows of blades in a turbomachine. Analytical expressions for the cross-flow velocity profiles are derived for these bounded boundary layers and are compared with experimental data. Author

N72-13268# Aeronautical Research Labs., Melbourne (Australia).
VISUALISATION OF SEPARATED FLOWS IN A WATER TUNNEL
D. H. Thompson Mar. 1971 13 p
(ARL/A-TM-266) Avail: NTIS

The visualization of separated flows in a ten inch by ten inch water tunnel is discussed. The flows are visualized using hydrogen bubbles and colored dyes. The techniques are used to build up a picture of the vortex flow over slender delta wings, but can be applied to other types of separated flow. Details of the techniques are given and the flow patterns obtained are illustrated. Author

N72-13269# National Research Council of Canada, Ottawa (Ontario).
ANALYSIS OF THE FLOW PAST A SHOCKLESS LIFTING AIRFOIL IN DESIGN AND OFF-DESIGN CONDITIONS
J. J. Kacprzynski, L. H. Ohman, P. R. Garabedian, and D. G. Korn Nov. 1971 88 p refs Presented at the 4th AIAA Fluid and Plasma Dynamics Conf., Palo Alto, Calif., 21-23 Jun. 1971
(Grant NGR-33-016-167)
(NRC-12315; LR-554) Avail: NTIS CSCL 20D

An airfoil designed for shockless inviscid flow at M sub infinity = 0.75 with C sub L = 0.63 was tested at high Reynolds numbers up to 27,000,000-in conditions. The experimental results are compared to theoretical ones, showing good agreement in general. Author

N72-13270*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
MIXING OF SUPERSONIC JETS INCLUDING THE EFFECTS OF SUPERSONIC JETS INCLUDING THE EFFECTS OF TRANSVERSE PRESSURE GRADIENT USING DIFFERENCE METHODS
Anatole P. Kurkov Washington Dec. 1971 31 p refs
(NASA-TN-D-6592; E-6386) Avail: NTIS CSCL 20D

The usual boundary-layer equations describing the steady-state mixing of parallel jets are supplemented by the momentum equation in the direction normal to the flow. This allows detailed computation of the flow field in the mixing region and simultaneous computation of the outer inviscid flow. An explicit and an implicit finite difference scheme have been developed and applied in several illustrative examples. The examples include mixing of planar and axisymmetric supersonic jets of different composition with both matched and unmatched static pressures. Numerical results were compared with available experimental data obtained for the unmatched pressure case. Author

N72-13271*# National Aeronautics and Space Administration. Langley Research Center. Langley Station, Va.
COMPUTER PROGRAM FOR CALCULATING SUPERSONIC FLOW ON THE WINDWARD SIDE CONICAL DELTA WINGS BY THE METHOD OF LINES
E. B. Klunker, Jerry C. South, Jr., and Ruby M. Davis Washington Jan. 1972 58 p refs
(NASA-TM-X-2438; L-7950) Avail: NTIS CSCL 20D

A user's manual is presented for a program that calculates the supersonic flow on the windward side of conical delta wings with shock attached at the sharp leading edge by the method of lines. The program also has a limited capability for computing the flow about circular and elliptic cones at incidence. It provides information including the shock shape, flow field, isentropic surface-flow properties, and force coefficients. A description of the program operation, a sample computation, and a FORTRAN 4 program listing are included. Author

N72-13272# National Aerospace Lab., Tokyo (Japan). Second Aerodynamics Div.
A METHOD FOR THE CALCULATION OF LIFTING POTENTIAL FLOW PROBLEMS. 1: THEORETICAL BASIS
Masao Ebihara Jul. 1971 27 p refs

(NAL-TR-240T) Avail: NTIS

A formulation of lifting potential flow problems is worked out in terms of a doublet distribution over the body surface and the trailing vortex sheet. In the course of analysis, it is shown that the velocity field due to a surface distribution of doublets is equivalent to that due to a surface distribution of vortices. This fact is utilized to derive a non-singular expression of surface derivatives of potential due to a doublet distribution. In view of the significance of the Kutta's condition in controlling the lifting flow field, the behavior of the potential and its derivatives is examined in tye neighbourhood of the trailing-edge of a wing. Conditions on the strength of doublets are thus obtained with which the flow velocity remains finite at the trailing-edge. These conditions are incorporated in the final formulation of the lifting potential flow field. Author

N72-13273*# Translation Consultants, Ltd., Arlington, Va.
EXPANSION OF A TURBULENT JET BOUNDARY LAYER IN A SLIPSTREAM
V. K. Temnov Washington NASA Dec. 1971 9 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Aviats. Tekh. (USSR), v. 13, no. 4, 1970 p 111-115
(Contract NASw-2038)
(NASA-TT-F-14060) Avail: NTIS CSCL 20D

A formula for the expansion of a boundary layer is checked experimentally, using circular and plane jets. A new formula for calculating the boundaries of the flow core is proposed which, in combination with the momentum equation, can be used to calculate the bounds of a jet boundary layer at the initial portion of the jet. An analytical expression describing the behavior of the axial velocity of the jet beyond its initial portion is obtained. Author

N72-13274# Lockheed Missiles and Space Co., Palo Alto, Calif.
ANALYSIS OF THE FLOW AROUND BODIES OF ARBITRARY SHAPE BY THE METHOD OF COARSE PARTICLES
Iu. M. Davydov [1971] 7 p refs Transl. into ENGLISH from Vychislitelnaya Matem. i Matem. Fiz. (USSR), v. 11, no. 4, 1971 p 1056-1063
Avail: NTIS; National Translations Center, John Crerar Library, Chicago, Ill. 60616

The extension of the coarse particle method to the case of flow around axisymmetric and plane bodies with an arbitrary generator (including breaks) at an angle of attack is examined. Problems of the external flow were computed by the method mentioned in a broad range of free-stream velocities, from the low subsonic to hypersonic and including the transonic. Special attention was paid to the transonic regimes. Presented as illustrations of the computation are data on the flow around a cone, a sphere, a circular cylinder, 12% plane and axisymmetric profiles, and a body of segmental shape, the Apollo type reentry vehicle. Author

N72-13275# Sandia Corp., Albuquerque, N.Mex.
CAVITATION STUDY OF UNDERWATER TRAJECTORY
J. C. Austin Jun. 1971 21 p Sponsored by AEC
(SC-RR-71-0277) Avail: NTIS

Small models are used in a water tunnel to simulate full-scale prototypes operating underwater. The water-tunnel parameters may be changed permitting cavity conditions to be varied. Problems currently being encountered in a high-speed (690 fps) tunnel are discussed. Author

N72-13276# Von Karman Inst. for Fluid Dynamics, Rhode Saint-Genese (Belgium).
MOTION OF FREELY FALLING SPHERES AT MODERATE REYNOLDS NUMBERS
Hermann Viets and D. A. Lee (ARL) Sep. 1971 23 p refs
(Grant NATO-478)
(VKI-TN-70) Avail: NTIS

A basic mechanism for the wandering of freely falling spheres, in certain ranges of Reynolds number and sphere-to-fluid density ratio, is shown to be coupling between rocking of the spheres and their motions perpendicular to the free fall direction. The rocking frequency is determined by small displacements of the spheres' centers of mass from their geometric centers. Author (ESRO)

N72-13277# ARO, Inc., Arnold Air Force Station, Tenn.
FLOW FLUCTUATION MEASUREMENTS AT MACH NUMBER 4 IN THE TEST SECTION OF THE 12-INCH SUPERSONIC TUNNEL D Final Report, 25 Jun. - 1 Aug. 1969
J. C. Donaldson and J. P. Wallace AEDC Aug. 1971 69 p refs
(Contract F40600-72-C-0003; ARO Proj. VT8002)
(AD-728630; ARO-VKF-TR-71-90; AEDC-TR-71-143) Avail: NTIS CSCL 14/2

Hot-wire anemometry measurements were made in a 12-in. supersonic tunnel to determine the level of flow fluctuations in the free stream. Supplementary acoustic measurements were made using a microphone mounted flush with the top surface of a flat plate. Data were obtained at Mach number 4. Reynolds number, based on the wire diameter, ranged from 5.0 to 24.0. The free stream results can be explained by the assumption of a sound source traveling in the tunnel wall boundary layer at a supersonic velocity relative to the free stream. The acoustic measurements on the surface of the flat plate revealed pressure fluctuation levels larger than those of the free stream by a factor of at least 20. Author

N72-13278# Harry Diamond Labs., Washington, D.C.
DETERMINATION OF VELOCITY DISTRIBUTION FOR ARBITRARY FLOWS OVER SOLID BOUNDARIES
Tadeusz M. Frzewiecki Jun. 1971 36 p refs
(AD-728143; HDL-TM-71-3) Avail: NTIS CSCL 20/4

The full Navier-Stokes equations, the equation of continuity, and measured values for local surface static pressure and skin-friction are used in a technique to determine the three components of velocity at any point away from a solid surface by expansion in a Taylor series. Analytical checks were made with fully developed laminar flow through a straight circular pipe, in which case the Taylor series with only two terms describes the field exactly, and for laminar flow over a flat plate where a comparison is made with the Blasius solution. In the latter case agreement is good when several terms in the Taylor series are taken. An experimental check was made on the velocity distribution on the center-line of a bounded jet, and the agreement was good. The analysis for turbulent flow indicates the necessity of making measurements of local correlations of fluctuating skin-friction in order to determine the mean velocities. Author (GRA)

N72-13279# Naval Postgraduate School, Monterey, Calif.
AN INVESTIGATION OF SUBSONIC DIFFUSER PERFORMANCE M.S. Thesis
Kevin Woods Sharer Jun. 1971 80 p refs
(AD-728574) Avail: NTIS CSCL 20/4

The report investigates subsonic diffuser performance, with emphasis on conical and annular geometries. A correlation is presented which aids in the prediction of performance. Two annular diffusers were designed and tested to help substantiate the correlation. Author (GRA)

N72-13280# Naval Postgraduate School, Monterey, Calif.
CURVED WALL BOUNDARY LAYER FLOW M.S. Thesis
K. R. L. Perera Jun. 1971 56 p refs
(AD-728575) Avail: NTIS CSCL 13/7

Mean velocities, turbulence intensities, and Reynolds stresses were measured in a circular convex wall jet. The entire mean velocity profile for angular position (theta = 35 degrees) was determined to be similar. The turbulent flow field was nowhere self preserving and thus the total flow was not similar. Strikingly

different jet growth rates were evidenced between the inlet (theta = 35 degrees) transition region and the fully developed flow regions (theta = 35 degrees). The overall level of turbulence was examined for a convex wall jet flow in comparison to a concave wall jet flow. The turbulent shear stresses were observed and did not vanish where the mean velocity gradient became zero. Hence for further analyses of turbulent convex wall jet flow the classical eddy viscosity models which neglect the effects of curvature appear inappropriate. GRA

N72-13281# Wisconsin Univ., Madison. Mathematics Research Center.
THE EXISTENCE OF AXIALLY SYMMETRIC FLOW ABOVE A ROTATING DISC
J. B. McLeod May 1971 50 p refs
(Contract DA-31-124-ARO(D)-462)
(AD-728463; MRC-TSR-1106) Avail: NTIS CSCL 20/4

The boundary value problem, arising from the behaviour of a fluid occupying the half-space x greater than 0, above a rozating disc which is coincident with the plane x = 0 and rotates about its axis which remains fixed is studied. The equations which describe axially symmetric solutions for this problem are given and the boundary conditions are defined. The existence is first proved by a fixed point method when the angular velocity of the disc is close to the angular velocity to which the fluid is subjected, and then extended for all angular velocities of the disc. Author

N72-13282# New York Univ., N.Y. Courant Inst. of Mathematical Sciences.
THE BRINK DEPTH OF A SUPERCRITICAL OVERFALL
Arthur S. Peters Jul. 1971 29 p refs
(Contract N00014-67-A-0467-0016; NR Proj. 062-160)
(AD-728799; IMM-390) Avail: NTIS CSCL 20/4

The report contains a first order analysis of the supercritical flow in an overfall based on the use of the stream line function as the basic dependent variable. It presents approximate equations for the nappes, and the formula for $f^*(1;epsilon)$ which is a good approximation to the brink depth ratio b/a for the range 0 < or = epsilon < or = 1. Author (GRA)

N72-13283# Von Karman Inst. for Fluid Dynamics, Rhode Saint-Genese (Belgium).
CONE CAVITY FLOW AT MACH 5.3 WITH INJECTION. EFFECT OF INCIDENCE Final Scientific Report, 1 May 1970 - 30 Apr. 1971
Jean J. Gineoux and Felix Thiry 30 Jun. 1971 61 p refs
(Grant EOOAR-0082-70; AF Proj. 9781-02)
(AD-728244; VKI-TN-75; AFOSR-71-2182TR; Rept-61102F; Rept-681307) Avail: NTIS CSCL 20/4

A previous experimental study of the favorable effect of mass injection into a hypersonic separated laminar flow on pressure and heat transfer distributions at reattachment has been extended to include the influence of a small incidence of the model. Measurements were made at M = 5.3 on a circular cone with an annular cavity, into which air was injected at rates up to approximately half the boundary layer mass flow at separation. Incidence was varied by halfdegree steps in the range zero to two degrees. The reattachment pressure and heat transfer peaks increased on the windward side with incidence and more mass injection was required to maintain them below a given level. The relative locations of these peaks were inverse at zero and two degrees incidence. Author (GRA)

N72-13284# Polytechnic Inst. of Brooklyn, Farmingdale, N.Y. Dept. of Aerospace Engineering and Applied Mechanics.
TURBULENT HEAT AND MASS TRANSFER IN AXISYMMETRIC JETS
Robert F. Mons and Pasquale M. Sforza May 1971 137 p refs
(Contracts Nonr-839(38); DAHC04-69-C-0077; ARPA Order 529; ARPA Order 1442-2)
(AD-728509; PIBAL-71-14) Avail: NTIS CSCL 20/4

The problem of turbulent mixing is examined with emphasis on mass, momentum, and energy transport in an axisymmetric free jet. An experimental investigation of the response of a pitot tube, a thermocouple and a sampling probe to a known periodic fluctuating flow with variable intensity of fluctuations is performed. The results indicate that the pitot tube response yields an adequate measure of the mean momentum flux in the incompressible range for any level of velocity fluctuation intensity in the direction of the probe axis. On the other hand, the thermocouple and sampling probe are found to be subject to significant errors in the measurement of mean temperature and mean concentration, respectively, in the high shear regions of a turbulent free jet. An experimental examination of the flow field of a turbulent axisymmetric free jet for non-homogeneous and non-isothermal conditions is performed. New probes are developed specifically for measuring these flux quantities. Author (GRA)

N72-13285# Systems Research Labs., Inc., Dayton, Ohio.
THE MACROSCOPIC CHARACTERISTICS OF SOME SUBSONIC NOZZLES AND THE THREE DIMENSIONAL TURBULENT JETS THEY PRODUCE
Charles N. Eastlake, II Wright-Patterson AFB, Ohio ARL Mar. 1971 104 p refs
(Contract F33615-70-C-1515; AF Proj. 7116)
(AD-728676; ARL-71-0058; DoD-Element-61102F; DoD-Subelement-681308) Avail: NTIS CSCL 20/4

An experimental investigation has been made of the characteristics of a number of subsonic nozzles and three-dimensional turbulent jets which they produce. Parameters investigated are primarily related to the efficiency with which the nozzles produce thrust and the transverse growth of the jets issuing from them. Data is presented which helps to elucidate the compromise which must be made between efficient thrust production and rapid jet spreading for application to the design of ejector primary nozzles. Most data is taken for jets exhausting into a quiescent atmosphere, but an extension of the data to a moving secondary stream is indicated and experimentally verified. Author (GRA)

N72-13286# Catholic Univ. of America, Washington, D.C. Inst. of Ocean Science and Engineering.
EXPERIMENTS ON THE FLOW ABOUT A YAWED CIRCULAR CYLINDER
Russell A. Smith, Timothy W. Kao, and Woo Taik Moon Dec. 1970 67 p refs
(Contract N00014-68-A-0506-0001)
(AD-725136; Rept-70-7) Avail: NTIS CSCL 13/9

Experiments were performed to evaluate the influence of yaw angle on circular cylinder pressure drag and wake characteristics in the range of free-stream Reynolds numbers 5000 to 20,000. It was found that the transition in the wake from laminar to turbulent motion was significantly promoted as the angle of yaw increased. As a result, wake properties such as base pressure and shear wave or transition frequency do not obey the independence principle which requires that properties be dependent only on the normal component of the free stream conditions. Author

N72-13287# Naval Academy, Annapolis, Md.
AN INVESTIGATION OF THE NUCLEATION PROBLEM IN ACOUSTIC CAVITATION
James B. Gallemore 18 May 1971 32 p refs
(AD-728766; USNA-TSPR-16) Avail: NTIS CSCL 20/4

The study aims to determine more precisely the nature of nucleation and stabilization in acoustic cavitation. Experiments involved treatment of fresh water so as to vary the size, number and other characteristics of motes. Filtration was the primary means of accomplishing this. A secondary purpose of the project was to design and construct a resonator and driving circuit which would be suitable for continued work in cavitation. The experiment data supports mote theory. Author (GRA)

N72-13288# Tennessee Univ., Tullahoma. Space Inst.
TRANSONIC FLOW FIELDS AROUND VARIOUS BODIES OF REVOLUTION INCLUDING PRELIMINARY STUDIES ON VISCOUS EFFECTS WITH AND WITHOUT PLUME Summary Report, Mar. 1970 - Apr. 1971
JainMing Wu, Kinya Aoyama, and Trevor H. Moulden 27 May 1971 64 p refs
(Contract DAAH01-69-C-1357; DA Proj. 1M2-326-XXA-206)
(AD-729335; RD-TR-71-12) Avail: NTIS CSCL 20/4

The report outlines the solution to the lifting slender body in transonic flow. Remarks are also made concerning the transonic flow past cone-cylindrical configurations. Preliminary calculations concerning viscous effects, and particularly plume induced separation, are included. Author (GRA)

13 GEOPHYSICS

Includes aeronomy; upper and lower atmosphere studies; oceanography; cartography; and geodesy. For related information see also: 20 Meteorology; 29 Space Radiation; and 30 Space Sciences.

N72-13289 World Meteorological Organization, Geneva (Switzerland).
WMO OPERATIONS MANUAL FOR SAMPLING AND ANALYSIS TECHNIQUES FOR CHEMICAL CONSTITUENTS IN AIR AND PRECIPITATION
1971 36 p refs
(WMO-299) Copyright. Avail: Issuing Activity

The monitoring of atmospheric composition and the study of the geophysical consequences of air pollution by the World Meteorological Organization is discussed. Data include guidelines for regional air pollution stations and turbidity measurements, including a description of the methods employing direct solar radiation instruments and the Volz type sunphotometer. Sampling and analysis techniques for determining chemical compbsition of precipitation are also covered. E.H.W.

N72-13290 National Lending Library for Science and Technology, Boston Spa (England).
ON CORRELATIONS BETWEEN INTEGRAL PARAMETERS OF THE GENERAL CIRCULATION OF THE ATMOSPHERE AT 500 mb
S. I. Inagamova, E. N. Milohova, and R. N. Hvostova 28 Apr. 1971 7 p refs Transl. into ENGLISH from Tr. Nauchn.-Issled. Inst. Gidrometeoro. Priborostr. (USSR), v. 62, no. 47, 1970 p 47-58
(NLL-M-20843-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

The question of the nature and scale of effects of the general circulation factors on local circulation is very important for problems of forecasting for a short time ahead. To discover this influence, correlations of the circulation characteristics are investigated. Author

N72-13291 National Lending Library for Science and Technology, Boston Spa (England).
SPACE ASPECT OF GEOLOGY
I. Luchitsky 15 Jul. 1971 3 p Transl. into ENGLISH from Pravda (Moscow), 28 Jun. 1971
(NLL-M-20759-(5828.4F); NLL-117H8769/B) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

The application of geologic techniques to bodies in outer space, and in particular to the solid-surface planets is presented. It is shown that processes observed on earth may occur on other bodies as well. K.P.D.

N72-13292 National Lending Library for Science and Technology, Boston Spa (England).
THE ROLE OF ADVECTION IN THE THERMAL INTERACTION OF SEA AND ATMOSPHERE
E. F. Babenkov 22 Sep. 1971 55 p refs Transl. into ENGLISH from Tr. Mosk. Gos Okeanogr. (Moscow), no. 84, 1965 p 132-169
(NLL-NSTIC-Trans-2451-(6180.59)) Avail: Natl. Lending Library, Boston Spa, Engl.: 5 NLL photocopy coupons

The basic laws and results of the inter-latitude heat transfer over the oceans and continents are established and analyzed. The significance of the general circulation of the atmosphere is that the coefficient of advection heat-transfer over the oceans is several times greater than the advection heat-transfer over the continents. Author

N72-13293 National Lending Library for Science and Technology, Boston Spa (England).
RELATION BETWEEN PHYTOPHENOPHASES AND THE HYDROTHERMAL REGIME IN THE DIFFERENT SEASONS
I. Tomkus [1971] 8 p refs Transl. into ENGLISH from Akad. Nauk Litov. SSR, Uprav. Gidrometsluzh. Litov. SSR, Hydromet. Regime Agroclim. Res. (Proc. 5th Natl. Conf.) (Vilnius), 1969 p 199-205
(NLL-M-20930-(5828.4F)) Avail.: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

Data on the relations between phytophenophase anomalies and climatic elements are given for the southern Baltic region Lithuaninian SSR in various seasons. The indicators of seasonal vegetation development are tabulated. Climatic parameters included daily mean air temperature and diurnal ranges of air temperature from 1923 to 1963 at one station, and daily amounts of precipitation and air humidity deficits for 1949 to 1963 at a second station. The main method of analysis was the scatter diagram. Correlation coefficients were also determined. K.P.D.

N72-13294*# Oregon Univ., Eugene. Center for Volcanology.
AN INVESTIGATION OF VOLCANIC DEPRESSIONS. PART 1: AIRFALL AND INTRUSIVE PYROCLASTIC DEPOSITS. PART 2: SUBAERIAL PYROCLASTIC FLOWS AND THEIR DEPOSITS
Howel Williams and Alexander R. McBirney 1 May 1969 103 p refs
(Grant NGR-38-003-012)
(NASA-CR-115235) Avail: NTIS CSCL 08G

Pyroclastic ejecta and the deposits they form were classified in many ways, and many interpretations were given to individual terms. Some classifications are based on the modes of orgin and deposition of the ejecta; others emphasized the chemical and physical composition of the ejecta. Particle-size was used as the prime basis of subdivision, and the same size-limits were used as those employed in the classification of sediments and sedimentary rocks. Author

N72-13295*# Oregon Univ., Eugene. Center for Volcanology.
AN INVESTIGATION OF VOLCANIC DEPRESSIONS. PART 3: MAARS, TUFF-RINGS, TUFF-CONES, AND DIATREMES Progress Report
Volker Lorenz, Alexander R. McBirney, and Howel Williams Apr. 1970 198 p refs
(Grant NGR-38-003-012)
(NASA-CR-115236) Avail: NTIS CSCL 08G

A classification of maars, tuff-rings, tuff-cones, and diatremes is given along with a summary of their lithologic and structural characteristics at the surface and at depth, and their probable manner of formation. Particular emphasis is placed on the roles of fluidization and groundwater. Author

N72-13296*# Earth Satellite Corp., Washington, D.C.
REMOTE SENSING FOR MINED AREA RECLAMATION: APPLICATION INVENTORY Final Report
1 Jun. 1971 39 p
(NASA-CR-124648; USGS-218) Avail: NTIS CSCL 08G

Applications of aerial remote sensing to coal mined area

reclamation are documented, and information concerning available data banks for coal producing areas in the east and midwest is provided. Mined area information requirements to which remote sensing methods might contribute are summarized. Author

N72-13297*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
GEOLOGY OF SELECTED LAVA TUBES IN THE BEND AREA, OREGON
Ronald Greely Portland, Ore. State of Oregon Dept. of Geol. and Mineral Ind. 1971 59 p refs
(NASA-TM-X-67438; Bull-71) Avail: NTIS CSCL 08G

Longitudinal profiles representing 5872.5 m of mapped lava tubes and a photogeologic map relating lava tubes to surface geology, regional structure and topography are presented. Three sets of lava tubes were examined: (1) Arnold Lava Tube System (7km long) composed of collapsed and uncollapsed tube segments and lava ponds, (2) Horse Lava Tube System (11 km long) composed of parallel and anastomosing lava tube segments, and (3) miscellaneous lava tubes. Results of this study tend to confirm the layered lava hypothesis of Ollier and Brown (1965) for lava tube formation; however, there are probably several modes of formation for lava tubes in general. Arnold System is a single series of tubes apparently formed in a single basalt flow on a relatively steep gradient. The advancing flow in which the tubes formed was apparently temporarily halted, resulting in the formation of lava ponds which were inflated and later drained by the lava tube system. Horse System probably formed in multiple, interconnected flows. Pre-flow gradient appears to have been less than for Arnold System, and resulted in meandrous, multiple tube networks. Author

N72-13298# Swiss Inst. of Meteorology, Zurich.
COMPARATIVE INVESTIGATIONS ON FOEHN FREQUENCY IN THE RHEIN VALLEY BETWEEN CHUR AND BODENSEE [VERGLEICHENDE UNTERSUCHUNGEN ZUR FOEHNHAEUFIGKEIT IM RHEINTAL ZWISCHEN CHUR UND BODENSEE]
Thomas Gutermann 1970 69 p refs In GERMAN; ENGLISH summary
(Rept-18) Avail: NTIS

The practical applicability discriminant analysis regarding the determination of foehn observations is examined. Most suitable characteristics for separating the cases of foehn were wind direction, wind speed, temperature and relative humidity of the stations in question. An additional utilization of large-scale variables does not produce any improvement. On the other hand, the separation of scheduled observations with foehn from those without foehn may be improved by appropriate modifications of the initial variables. Thus, wind direction and wind speed are combined to form a common wind index, and regarding temperature and humidity, the mean diurnal and annual variations are excluded. Among the three variables of the discriminant function, the wind index furnished the largest portion of the resulting foehn index on account of its excellent dividing quality. In order to stress the importance of temperature, and especially of humidity, the marginal cases (ca. 10% of all observations) are tested again with a second discriminant function, which includes only these two variables. The discriminant functions determined on the basis of samples are specific to one station and therefore cannot be applied to any other places. The use of two functions in steps induces an increased accuracy of the processes. Author

N72-13299# Swiss Inst. of Meteorology, Zurich.
USING ATMOSPHERIC OZONE TO TRACE EXCHANGE PROCESSES OCCURRING BETWEEN THE TROPOSPHERE AND THE STRATOSPHERE
Alexandre Piaget 1971 71 p refs In FRENCH; ENGLISH summary
(UDC-551.510.534:551.510.528; Rept-21) Avail: NTIS

After a review of the present state of the art of the exchange procedures between troposphere and stratosphere, the layer structure of the atmosphere is discussed. At the same time the conventional definition of the tropopause is the subject of a critical consideration. Measurements of the vertical ozone distribution confirm the recent theory of stratospherical polar air intrusions along the frontal surface into the troposphere (case of 26th May 1967). They also state that stratospherical air with positive temperature lapse rate appears beneath the tropopause (case of 12th June 1967) and that, on the other side, also tropospherical and stratospherical tropical air can enter into the polar stratosphere (case of 17th February 1967). Finally, a rough draft is made of the general exchange of the troposphere and the lower stratosphere. Author

N72-13300# Swiss Inst. of Meteorology, Zurich.
THE RISK OF FROST AND FROST PREDICTION
B. Primault 1971 18 p In FRENCH; ENGLISH summary
(UDC-551.524.37; Rept-20) Avail: NTIS

A simple procedure, using Kammermann's rule of 1885, is examined in an attempt to predict the minimum temperature reached by plant life during spring nights. Critical, historical, and personal opinions are reviewed. Eight zones were set up between the Valasis north of the Alps, and the northern region of Grisons. Each zone was assigned a specific relation. From meteorological data collected by Swiss frost observation networks, surveys of the risks according to station and region were made, with emphasis on especially dangerous periods, or limited danger only. Some peasant weather lores with regards to frost prediction are also considered. Author

N72-13301*# Johns Hopkins Univ., Baltimore, Md. Dept. of Physics.
SOME PHOTOMETER RESULTS OBTAINED ON THE NASA 1969 AIRBORNE AURORAL EXPEDITION
K. A. Dick, G. G. Sivjee, W. G. Fastie, and R. C. Schaeffer May 1971 78 p refs
(Grants NGR-21-001-001; NGR-21-001-070)
(NASA-CR-124719; TR-27) Avail: NTIS CSCL 03B

The spectral features measured by a photometer onboard the Convair 990 Galileo, during the Auroral Expedition are given in tables. The measurements given cover flights 3 to 15. E.H.W.

N72-13302*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
EARTH RESOURCES RESEARCH DATA FACILITY R AND D FILE. VOLUME 1: DOCUMENTARY DATA
Jul. 1971 505 p ref
(NASA-TM-X-67421; MSC-02577-Vol-1) Avail: NTIS CSCL 08G

Cumulative listings of the R and D file data are presented. All Earth Resources Program information available at the Manned Spacecraft Center is in Vol. 1. Sensor data collected during flights over NASA test sites and from missions flown by subcontractors supporting the Earth Resources Survey Program are included in Vol. 2. Author

N72-13303*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
EARTH RESOURCES RESEARCH DATA FACILITY R AND D FILE. VOLUME 2: SENSOR DATA
Jul. 1971 339 p ref
(NASA-TM-X-67420; MSC-02577-Vol-2) Avail: NTIS CSCL 08G

For abstract, see N72-13302.

N72-13304*# Colorado State Univ., Fort Collins. Dept. of Watershed Sciences.
MATHEMATICAL MODELS FOR RADIATION TRANSFER Final Report
W. E. Marlatt, J. C. Harlan, and H. L. Cole Jul. 1971 49 p refs
(Grant NGR-06-002-038)
(NASA-CR-124814) Avail: NTIS CSCL 04A

A radiation transfer model was modified to include

semitransparent and opaque layers as well as molecular constituents. An example of the use of the program and an analysis of the mathematical model are included. Author

N72-13305*# Lockheed Missiles and Space Co., Sunnyvale, Calif. Biotechnology Organization.
THE DEVELOPMENT OF A NONCRYOGENIC NITROGEN/OXYGEN SUPPLY TECHNIQUE Final Report
B. M. Greenough Feb. 1971 280 p refs
(Contract NAS9-10405)
(NASA-CR-114912) Avail: NTIS CSCL 22B

A development program was conducted in two phases to define the characteristics and requirements of an electrochemical oxygen/nitrogen supply technique for space station application. In Phase 1, electrode formulations and structures suitable for use as anodes in an oxygen/nitrogen generator were experimentally investigated. A one-man model oxygen/nitrogen generator integrated with a space cabin atmosphere simulator was fabricated and successfully tested in Phase 2. Data from these tests were used to update a computer routine model of the cabin atmosphere control using the oxygen/nitrogen generator technique. A specification and preliminary design for a 12-man oxygen/nitrogen generation system was prepared. Author

N72-13306*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
ATMOSPHERIC SAMPLING DEVICES Patent Application
James E. Lovelock and Peter G. Simmonds, inventors (to NASA)
Filed 15 Oct. 1970 23 p
(Contract NAS7-100)
(NASA-Case-NPO-11373; US-Patent-Appl-SN-81095) Avail: NTIS CSCL 04A

An atmosphere sampling chamber is disposed within a container. The chamber has an inlet communicating with the atmosphere to be sampled and an outlet communicating with an analysis device such as a gas chromatograph. The annulus in the container adjacent to the outer walls of the chamber contains a fluid medium for pressurizing the chamber in order to exhaust its contents through the outlet. Two variations of the apparatus are described. NASA

N72-13307# Aerojet-General Corp., El Monte, Calif. Microwave Div.
MICROWAVE RADIOMETRIC INVESTIGATIONS OF SNOWPACKS Final Report, 20 Aug. 1968 - 1 Sep. 1970
A. T. Edgerton, A. Stogryn, and G. Poe Jul. 1971 89 p refs
(Contract USGS-14-08-001-11828)
(IR-USGS-230; DI-DO-71-018; Rept-1285R-4) Avail: NTIS

Basic and applied research into the microwave radiometric emissions of snowpacks encompassed multifrequency measurements of a large variety of snowpacks, numerical modeling of snowpack emission, dielectric constant measurements and techniques, and laboratory bistatic reflectivity measurements of selected snow samples. Experiments demonstrated that direct empirical relationships exist between snowpack and water equaivalent and its microwave emission. Theoretical studies which accounted for subsurface snow structure provided mainly qualitative reasons for interpretation of results, but generally did not agree with measured data, probably owing to the inadequacy of present snowpack models to account for nonspecular surface scattering associated with small-scale surface irregularities and volume scattering associated with random volume inhomogeneities. Author

N72-13308# Joint Publications Research Service, Washington, D.C.
INTERACTION OF THE COMPONENTS IN THE OCEAN-ATMOSPHERE-CONTINENT SYSTEM
V. V. Shuleykin 10 Dec. 1971 22 p Transl. into ENGLISH from Priroda (Moscow), no. 10, Oct. 1971 p 12-21
(JPRS-54672; UDC-551.51:551.46.551.41) Avail: NTIS

Temperature isanomals of air above the oceans and over the continents are used to derive a mathematical model for the formation of climate. Isolines are obtained through heat exchange analyses between cyclic flows in the oceans, surrounding water surfaces, and the atmosphere above the ocean water. G.G.

N72-13309# Joint Publications Research Service, Washington, D.C.
DETERMINATION OF SOME CHARACTERISTICS OF SOIL BASED ON DATA OF MEASUREMENTS OF ITS MICROWAVE RADIATION
K. Ya. Kondratyev and Ye. M. Shulgina 10 Dec. 1971 4 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 200, no. 1, Sep.-Oct. 1971
(JPRS-54677; UDC-551.526) Avail: NTIS

Methods are described for determining the moisture of soil, the temperature gradient at the surface, the surface reflection factor, and the temperature profile's exponential factor. The constant component of the radio brightness temperature and the amplitude of its first harmonic are measured at three wavelengths. These data are then used to determine the soil characteristics accurately. N.E.N.

N72-13310*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
OBSERVATIONS OF ACTIVELY FORMING LAVA TUBES AND ASSOCIATED STRUCTURES, HAWAII, PART 2
Ronald Greeley (Santa Clara Univ.) Nov. 1971 10 p refs
(NASA-TM-X-62096) Avail: NTIS CSCL 08G

A ground examination is made of lave tubes and channels. The surface morphology and the changes noted through lava flow activity are cited, and compared to earlier aerial observations. The lava activity was believed to be caused by a small lava lake exposed by the collapse of a crust covering it. Drainage of the lake was caused by a fissure erruption. New tubes or extensions of existing ones were noted from the flow. Molten lava was not seen in any tubes examined on the ground, but some of the flows were not sufficiently cooled to allow subsurface examination and survey of the tubes. E.H.W.

N72-13311# Research Inst. of National Defence, Stockholm (Sweden).
HAGFORS OBSERVATORY Annual Report, 1970
Ola Dahlman, Hans Israelson, Gunnel Hoernstroem, Boertje Soederstroem, Ragnar Slunga, Harold Waegner, Leif Nordgren, and Ingvar Nedgard Jun. 1971 34 p refs
(FOA-4-A-4501-26) Avail: NTIS

Operational performance of the Observatory and seismic and microbaric data from announced or presumed nuclear explosions are presented. The detection and location capabilities of the station have been studied for teleseismic and local events. The spectral content of P-waves recorded at HFS was studied for different epicenter regions and a study of the time variation of the high frequency noise field was conducted. Identification by body and surface wave magnitudes, by short period spectral ratio and by complexity by means of HFS data was studied for US and USSR explosions and North American and Eurasian earthquakes. Author

N72-13312# Joint Publications Research Service, Washington, D.C.
STATISTICAL MODEL OF SEISMICITY AND EVALUATION OF MAJOR SEISMIC EFFECTS
L. V. Kantorovich, G. M. Molchan, V. I. Keylis-Borok, and Ye. V. Vilkovich 23 Dec. 1971 27 p refs Transl. into ENGLISH from Izv. Akad. Nauk SSSR (USSR), no. 5, 1970 p 85-102
(JPRS-54784) Avail: NTIS

A procedure is suggested for evaluating confidence intervals and statistical distribution functions for the major effects of a succession of earthquakes on a particular object. The evaluations are formalized for a Poisson model of the earthquake sequence. Calculations were made for the frequency of earthquakes and parameters of the frequency distribution of earthquakes all over

the world. An estimate was made of the total length of sectors of a linear object experiencing shocks of shock strength 8 and 9 in eastern Siberia. The economic effect of earthquakes is also considered. Author

N72-13313# Royal Inst. of Tech., Stockholm (Sweden). Div. of Plasma Physics.
POTENTIAL DOUBLE LAYERS IN THE IONOSPHERE
Lars P. Block [1971] 48 p refs Sponsored by Statens Naturv. Forskningsraed
(TRITA-EPP-71-14) Avail: NTIS

Double layers (sheaths) are frequently observed in laboratory discharges but are largely overlooked in space physics. Recent observatiofs have indicated the existence of sheaths in the upper ionosphere. A review of sheath theories in plasmas is given in terms of macroscopic equations for thermal plasmas. The role of Bohm criteria for the existence of sheaths is analyzed. The Langmuir condition is rederived and demonstrated for stationary and moving sheaths. Also treated are sheaths with reduced or vanishing current, and particles trapped between sheaths and magnetic mirrors. Finally, consequences of sheaths in space for auroral particle acceleration and auroral forms are discussed. In particular, it is shown that both stable and transient sheaths may be associated with simultaneous precipitation of ions and electrons. Author (ESRO)

N72-13314# Academy of Sciences (USSR), Moscow. Inst. for Space Research.
ON THE THEORETICAL MODELS OF STRUCTURE AND DYNAMICS OF THE EARTH'S THERMOSPHERE
M. N. Izakov 1970 95 p refs
(OB-6) Avail: NTIS

A theoretical model of the thermosphere structure and dynamics is constructed. An attempt is made to calculate the structural parameter distribution and variations taking into account available data on short wave solar radiation and atmospheric particle characteristics. It is concluded that for improving the atmospheric model it is necessary to study the turbulence in the upper atmosphere, the fundamental heat transfer processes and to investigate other sources of energy in the thermosphere.
ESRO

N72-13315# Stockholm Univ. (Sweden). Inst. of Meteorology.
AN ACTIVE OPTICAL SONDE FOR THE MEASUREMENT OF THE RELATIVE AIR DENSITY PROFILE AND THE EXPLORATION OF NON-MOLECULAR PARTICLE LAYERS IN THE UPPER ATMOSPHERE
Joachim Mueller, Karl-Olof Bonow, and Georg Witt Jan. 1971 47 p refs Sponsored in part by Swed. Space Res. Comm. and ESRO
(AP-3) Avail: NTIS

A rocket-borne sonde is described which measures in situ the backscattering function of the atmosphere up to 90 km altitude. The backscattering function is obtained for two separate wavelength-regions which makes it possible to separate the Rayleigh- and aerosol contributions to the received signal. The electrical signals, produced by the receiving photometers, are integrated in a 3-mode-integrator. A calculation of the signal strength and measuring accuracy is given and some ground based test results are presented. Author (ESRO)

N72-13316# Institut Royal Meteorologique de Belgique, Brussels.
GEOPHYSICAL OBSERVATIONS Monthly Bulletin, Nov. 1970 [OBSERVATIONS GEOPHYSIQUES BULLETIN MENSUEL, NOVEMBRE 1970]
1970 28 p In FRENCH and DUTCH
Avail: NTIS

Geophysical data obtained at Dourbes (Belgium) relating to geomagnetism, air radioactivity, ionospheric parameters, seismology, atmospheric electricity, and cosmic rays during Noember 1970 are presented. ESRO

N72-13317# Royal Inst. of Tech., Stockholm (Sweden). Dept. of Plasma Physics.
DETERMINATION OF IONOSPHERIC DENSITY AND TEMPERATURE USING A DOUBLE PROBE ELECTRIC FIELD DETECTOR
A. Pedersen (ESRTC), U. Fahleson, and C.-G. Faelthammar Jun. 1971 20 p refs Sponsored in part by Swed. Space Res. Comm.
(TRITA-EPP-71-29) Avail: NTIS

Temperature and density information obtained from two skylark rocket flights from ESRANGE (65.3 deg N geomagnetic latitude) during twilight on 14 February 1970 and on 2 April 1970 are discussed. A small magnetic disturbance (Delta H = +40 gammas) was in progress during the first flight and an auroral E-layer of a few MHz was observed. No magnetic disturbance was present during the second flight. It is concluded that with very little extra circuitry a double probe on a spinning rocket can be used for separate measurements of electron density and temperature. It is argued that in particular the electron temperature data obtained in this way are more reliable than those obtained by conventional single Langmuir probes.
Author (ESRO)

N72-13318# European Space Research Inst., Frascati (Italy).
NONLINEAR THEORY OF CROSS-FIELD AND RESISTIVE TWO-STREAMS INSTABILITIES WITH APPLICATION TO THE EQUATORIAL ELECTROJET
Andre Rogister 1971 10 p refs Submitted for publication
Avail: NTIS

A nonlinear theory of the cross-field instability is presented in which the energy is transferred by mode coupling from large to small wavelengths where it is absorbed by linear damping (classical diffusion). Nonlinear coupling is also relevant to the theory of the two-stream instability in weakly ionized gases. The parameters are chosen to fit the conditions prevailing in the equatorial electrojet where both instabilities can develop.
Author (ESRO)

N72-13319# European Space Research Organization, Paris (France).
THE PHYSICAL AND TECHNOLOGICAL BACKGROUND OF REMOTE SENSING
J. Plevin Aug. 1971 43 p refs Presented at the Tech. Consultation on the Appl. of Remote Sensing to the Management of Food and Agr. Resources, Rome, Sep. 1971
Avail: NTIS

An introductory review, the main topics discussed are the basic physics of remote sensing, restricted to sources and interactions of electromagnetic energy between the ultraviolet and microwave regions of the electromagnetic spectrum. Information is given on (1) the influence of the intervening atmosphere between the object under study and the remote detector, (2) the technological background to remote sensing, mentioning sensor types, remote sensing systems and methods, and (3) the different types of platforms used to mount remote sensing instruments, with particular attention to aircraft and satellite sensor platforms. ESRO

N72-13320# Institut Royal Meteorologique de Belgique, Brussels.
ATMOSPHERIC POLLUTION SMOKE, AND SULFUR DIOXIDE Monthly Bulletin, Feb. 1971 [POLLUTION ATMOSPHERIQUE, FUMEE ET ANHYDRIDE SULFUREUX BULLETIN MENSUEL, FEVRIER 1971]
1971 28 p In FRENCH and DUTCH Prepared jointly with Inst. d'Hyg. et d'Epidemiol.
Avail: NTIS

Data obtained at Belgian weather stations in February 1971 are tabulated. The air pollution apparatus is briefly described.
ESRO

N72-13321# Royal Inst. of Tech., Stockholm (Sweden). Dept. of Plasma Physics.
MAGNETOSPHERIC PROCESSES

Carl-Gunne Faelthammar Oct. 1971 29 p refs Presented at the Earth's Particles and Fields Conf., Cortina, Italy, 3 Aug. 10 Sep. 1971
(TRITA-EPP-71-19) Avail: NTIS

Results from the fundamental physics phase in magnetospheric research are summarized in a brief phenomenological survey. The distribution in the different layers of the magnetosphere of the three classes of plasma based on the value of the mean free path relative to giroradius is analyzed. Cross fertilization of magnetospheric plasma research on the one hand and research on thermonuclear fusion reactors and plasma physics laboratories on the other, are discussed. ESRO

N72-13322# Genoa Univ. (Italy). Inst. of Geophysics and Geodetics.
ROBURENT (CUNEO) OBSERVATORY: MAGNETIC BULLETIN, JANUARY - DECEMBER 1970
[1971] 41 p refs Sponsored in part by CNR
Avail: NTIS

Geomagnetic field direction and intensity was recorded hourly during 1970, with a La Cour-type variometer. Tables of data are given. ESRO

N72-13323# Lincoln Lab., Mass. Inst. of Tech., Lexington.
SEISMIC DISCRIMINATION Semiannual Technical Summary Report, 1 Jan. - 30 Jun 1970
David Davies 30 Jun. 1971 69 p refs
(Contracts F19628-70-C-0230; AF 49(638)-1763; ARPA Order 512)
(AD-728210; ESD-TR-71-191) Avail: NTIS CSCL 17/10

Progress in the definition of spectral characteristics of explosions and earthquakes and in the determination of their time functions is reported. The complexities of surface wave and body wave propagation in a heterogeneous Earth are further considered, and the coherence of seismic signals is discussed with reference to different mantle regions. A technique for computing signals reflected from transition layers is given. The first NORSAR data show travel-time anomalies much more complex than could be associated with sub-NORSAR structure. NORSAR spectraforms are described for several Asian events. A transfer function technique is used to determine sub-LASA structure. Significance tests for Vespagram and Beamsplit displays are described. Upgrading of the Lincoln data analysis facilities is reported. Author (GRA)

N72-13324# Michigan Univ., Ann Arbor. Dept. of Geology and Minerology.
CORRELATION OF INFRASONIC MICROBAROMETRIC DISTURBANCES AND LONG PERIOD SEISMIC PHENOMENA Final Report, 1 Feb. 1969 - 31 May 1971
Paul W. Pomeroy and Malcolm J. S. Johnston Jun. 1971 51 p
(Contract F44620-69-C-0085; ARPA Order 1363)
(AD-728643; Rept-026370-2-F; AFOSR-71-2281TR; ARPA-Program-Code-9F20; Rept-62701D) Avail: NTIS CSCL 08/11

Detailed analyses of the correlation of infrasonic microbaroxetric disturbances and long-period seismic phenomena as recorded at the high-gain, wide-band, long-period seismic observatory at Sugar Island, Michigan, show very low coherency in the range of periods between 10 and 120 sec. At periods greater than 60 sec, rising levels of microbarometric power generally correspond to rising levels of seismic 'noise' power indicating a genetic relationship. The lack of coherency between the data is attributed to the fact that a single point microbarometric measurement at the seismic recording site does not adequately represent the atmospheric loading of the earth's surface. To obtain high coherency, an array of weighted microbarometric measurements should be obtained in an area approximately 10 km in diameter around a broad-band, high-gain seismic receiver. A pronounced minimum in the seismic noise between 30 to 40 sec was observed in accordance with Savino's observations.
Author (GRA)

N72-13325# Army Foreign Science and Technology Center, Charlottesville, Va.
ACCOMPLISHMENTS AND SCIENTIFIC-TECHNOLOGICAL PROGRESS IN TOPOGRAPHIC AND GEODESIC PRODUCTION
L. A. Kashin, Yu. P. Kienko, B. A. Larin, and M. G. Gerasimenko 21 Jul. 1971 12 p Transl. into ENGLISH from Geodeziya i Kartografiya (USSR), no. 4, 1970 p 46-51
(AD-728148; FSTC-HT-23-819-71) Avail: NTIS CSCL 08/5

Geodesic and cartographic activities in the USSR will be aided by a number of new instruments listed in this article.
Author (GRA)

N72-13326# Atmospheric Sciences Lab., White Sands Missile Range, N.Mex.
THE VERTICAL DISTRIBUTION OF OZONE NEAR THE EQUATOR
R. S. Randhawa Apr. 1971 33 p refs
(AD-728809; ECOM-5371) Avail: NTIS CSCL 04/1

An experiment to monitor the ozone concentration in the upper stratosphere and lower mesosphere was performed at Panama Canal Zone during the first two weeks in November 1970. The rocketborne ozonesonde, a self-pumping device which incorporated a temperature-sensing bead thermistor on a time-sharing basis with the ozone sensor, was used for this study. Two electrochemical ozonesondes (Mast type) with the AMI-12 Radiosondes were flown on balloons, one on 9 November and the other on 12 November 1970. Resulting temperature and ozone data are presented. Author (GRA)

N72-13327# Radiation Research Associates, Inc., Fort Worth, Tex.
MONTE CARLO CALCULATIONS IN SPHERICAL-SHELL ATMOSPHERES
Wolfram G. Blattner, Dave G. Collins, and Michael B. Wells 1 Jun. 1971 83 p refs
(Contract F19628-70-C-0156)
(AD-728261; RRA-T7104; SR-2; AFCRL-71-0382) Avail: NTIS CSCL 20/6

The FLASH procedure was modified so that a printout of both the scattered intensity and the polarization parameters could be obtained as a function of the receiver polar and azimuthal angles. Calculations were run with FLASH for Rayleigh atmospheres with optical thicknesses of 0.25 and 1.0 for comparison with the data reported by Coulson, Dave and Sekera, and for a homogeneous Mie-Rayleigh atmosphere with a turbidity factor of 2 for comparision with the data reported by Bullrich, Eschelbach, et al. The FLASH procedure was modified to incorporate several methods of improving the accuracy of both single and higher order scattering calculations for twilight studies. The procedure was then used in a study to determine the effect of several assumed dust profiles on both the single and multiple scattered radiation under twilight illumination for 0.5 and 0.7 micrometer wavelength light. Results are presented which show how the color ratio (1 (lambda = 0.7 microns)/1 (lambda = 0.5 microns)) varies with the sun depression angle for a number of different dust profiles. GRA

N72-13328# Naval Postgraduate School, Monterey, Calif.
DEVELOPMENT AND TESTING OF AN ACOUSTIC SYSTEM FOR IN SITU DETERMINATION OF MICROBUBBLE CONCENTRATIONS IN THE OCEAN M.S. Thesis
Leonard Arnold Wiens Jun. 1971 43 p refs
(AD-728691) Avail: NTIS CSCL 14/2

The effect of bubbles on sound propagation in the ocean has long been known. More recently, bubbles rising to the ocean surface have been related to salt nuclei in clouds. Yet due to the lack of suitable instrumentation little data are available on the concentration of bubbles in the ocean. A one-dimensional standing wave system was constructed and evaluated to determine bubble concentrations by measuring the effect of bubbles on the system damping constant 1/Q. The system was comprised of a mylar electrostatic transducer built

into a plane reflector facing a parallel reflecting plate, and associated electronic components. The system was designed to measure bubbles of radius from approximately 500 microns to 30 microns utilizing frequencies from 20 to 100 kHz at depths to 30 meters. The system accuracy was determined to be plus or minus 10Hz in resonant bandwidth corresponding to 500 bubbles/cum at 67 kHz. The system was used to successfully measure bubbles in a laboratory tank. Author (GRA)

N72-13329# Lamont Geological Observatory, Palisades, N.Y.
ARCTIC OCEANOGRAPHIC MEASUREMENTS FROM DRIFTING ICE ISLANDS, 1. GRAVITY OBSERVATIONS, 2.
Kenneth L. Hunkins and Manik Talwani Apr. 1971 129 p refs
(Contract Nonr-266(79); NR Proj. 083-500)
(AD-728803) Avail: NTIS CSCL 08/7

Investigations in hydroacoustics and marine geophysics were conducted from two drifting ice stations, T-3 and Arlis II, in the Arctic Ocean. Long range sound propagation experiments were made over a number of paths between ice stations and also with icebreakers. The signals from explosives are transmitted to great ranges in the Arctic surface SOFAR channel. The character of these signals is explained in principal by both ray and mode theory. Background noise is created by cracking and crushing of the ice cover. The sources and variability of the background noise are discussed. Geophysical investigations included navigation, ocean depth, gravity and magnetics. Marine geological investigations included bottom photography, nephelometry and coring. Improvement of accuracy of sea gravity measurements by consideration of the cross coupling and off leveling errors is discussed. The use of satellite navigation for increasing navigational accuracy and hence the accuracy of gravity measurements is described. Author (GRA)

N72-13330# California Univ., La Jolla. Advanced Ocean Engineering Lab.
[OCEAN ENGINEERING RESEARCH AND INSTRUMENT DEVELOPMENT] Technical Progress Report, 1 Jan. - 30 Jun. 1971
William A. Nierenberg, Fred N. Spiess, Walter H. Munk, Robert D. Moore, William A. Prothero, Hugh-Bradner, John D. Isaacs, Douglas L. Inman, and William G. VanDorn 30 Jun. 1971 141 p refs
(Contract N00014-69-A-0200-6012; ARPA Order 1730; ARPA Order 1607)
(AD-728796; AOEL-23; SIO-31-22) Avail: NTIS CSCL 08/3

The annual report reflects the technical status of projects conducted within the Advanced Ocean Engineering Laboratory at the Scripps Institution of Oceanography. These projects are: (1) Stable Floating Platform - to conceive, design, build and demonstrate the feasibility of large stable floating platforms in the open sea. (2) Benthic Array - a program to develop and construct a quartz vertical accelerometer appropriately packaged and adapted for long term ocean bottom or perhaps sub-bottom use. (3) Overpressure Due to Earthquakes- a study of earthquakes, seaquakes and resultant overpressures as they may effect subsurface vehicles and structures. (4) Advanced Studies in Nearshore Engineering - field studies of the water-sediment interface under wave action in and near the breaker zone; and laboratory investigation of the velocity field of breaking waves. (5) Electro-magnetic Roughness of the Ocean Surface - utilization of radio signals scattered from the sea surface to determine the directional spectrum of ocean waves. Author (GRA)

N72-13331# Northern Research and Engineering Corp., Cambridge, Mass.
STUDIES OF TURBULENT MIXING AND COMBUSTION IN SUPERSONIC HETEROGENEOUS FLOWS Final Scientific Report
Kenneth N. C. Bray, Ronald S. Fletcher, Richard J. Murad, and D. B. Spalding Apr. 1971 45 p refs
(Contract F44620-70-C-0041; AF Proj. 9711)
(AD-728675; NREC-1157-1; AFOSR-71-1915TR; Task-61102F; Task-681308) Avail: NTIS CSCL 21/2

The objective of the program was the development of analytical models of various flow configurations which can be used in the design of supersonic air-breathing propulsion systems. The work described in the report represents an extension of earlier studies in the program to conditions that exist in air-augmented rocket systems. These conditions vary according to the nature of the rocket propellant, as liquid propellants usually produce only gaseous fuel-rich combustion products whereas solid propellant rockets emit heterogeneous products which contain small combustible particles. The inclusion of particles produces significant effects upon reacting turbulent flows, particularly when the particles themselves continue to burn. Some predictions of their behavior in a reacting flow field are presented. A series of systematic tests has been planned by which the experimental conditions proceed stepwise through conditions of increasing primary stream (rocket exhaust) complexity starting with a cold nonreactive gas and ending with a hot, reactive, heterogeneous mixture. The method permits the effects of temperature, of gaseous combustion and solid combustion upon a supersonic, reacting flow field to be isolated. Results obtained from the experimental tests are presented, and some conclusions are drawn from the data. Author (GRA)

N72-13332# Naval Postgraduate School, Monterey, Calif.
CONVERSION OF TWO-MAN SUBMERSIBLE FOR SHALLOW DEPTH OCEANOGRAPHIC RESEARCH. PHASE 2: POTENTIAL UTILIZATION, INSTRUMENTATION STUDY M.S. Thesis
Thomas Mark Fisher Jun. 1971 104 p refs
(AD-728690) Avail: NTIS CSCL 13/10

A multi-phase project directed toward determining the suitability of a two-man, shallow depth submersible in oceanographic research is in progress at the Naval Postgraduate School. This thesis, Phase II of the project, addresses the instrumentation and potential oceanographic use of the craft. Based on previous submersible and habitat oceanographic operations, projected utilization of the craft, Sea Otter, has been specified for applications in biology, geology, acoustics, chemistry, and physical oceanography. Modifications recommended to amplify Sea Otter's research potential include addition of an equipment brow and a manipulator as well as substitution of fiberglass units for the steel ballast tanks. Designs for the brow and manipulator are proposed. Author (GRA)

N72-13333# Naval Underwater Systems Center, Newport, R.I.
IMPROVED DISCRETE DEPTH SAMPLER
David F. Giuliano and George F. Battista 20 Mar. 1971 13 p refs
(NUSC Proj. A-400-03-00; Subproj. SF-11-552-101-12856)
(AD-725113; NUSC-4083; Code-TA131; Code-EB2; NAVSHIPS-00V1) Avail: NTIS CSCL 20/1

The report describes improvements in the electronics system controlling the four-chambered discrete depth sampler (DDS) on an Isaacs-Kidd Mid-water Trawl. A resonant reed relay and voltage transfer relays are utilized to control the solenoids that close the doors of the DDS. The improved system is more reliable and allows greater flexibility than the original system. Author (GRA)

N72-13334# Naval Undersea Research and Development Center, San Diego, Calif.
NUC SYMPOSIUM ON ENVIRONMENTAL PRESERVATION
Mar. 1971 190 p refs Conf. held at San Diego, Calif., 20-21 May 1970
(AD-724709; NUC-TP-215) Avail: NTIS CSCL 13/2

The proceedings of a symposium on environmental control are presented. Subjects discussed are: (1) water pollution, (2) air pollution, (3) marine biology, (4) noise pollution, (5) solid waste disposal, (6) toxicity of pollutant's and (7) recommendations for reducing effects of pollution. Author

N72-13335# Washington Univ., Seattle. Applied Physics Lab.
ARCTIC TECHNOLOGY PROGRAM AT THE UNIVERSITY OF WASHINGTON Annual Report, 1 Jun. 1970 - 30 Jun. 1971
Stanley R. Murphy 20 Aug. 1971 162 p refs
(Contract N00014-67-A-0103-0016; ARPA Order 1668)
(AD-728815) Avail: NTIS CSCL 08/12

A synopsis of the sponsored arctic technology development at the University of Washington is presented. This includes a description of the technical management plan which has been used to administer the program; final reports from the four technical investigations that were undertaken (the design of an unmanned, untethered arctic research submersible, the study of arctic research missions for surface effect vehicles, the experimental development of a lightweight pack-ice shelter module and the experimental development of a thermal ice-coring mechanism; and a description of several concepts for new arctic technology which are being considered.
Author (GRA)

N72-13336# Florida Univ., Gainesville. Communication Sciences Lab.
A SYMPOSIUM ON SCIENTIST-IN-THE-SEA
Harry Hollien and Howard Rothman 1 Jun. 1971 10 p Symp. held in Gainesville, Fla., 27-30 Apr. 1971
(Contract N00014-68-A-0173-0008)
(AD-729054; CSL/ONR-32) Avail: NTIS CSCL 08/10

The Scientist-in-the-Sea Symposium was conducted in order to learn more about the role of the scientific diving community in the exploration and utilization of hydrospace. The focus of the Symposium was on three major areas: (1) The problems encountered by the diving scientist and the state of technology relative to those problems; (2) an overview of how the scientist works in the sea; and (3) development of a program to train scientists to work effectively in the sea.
Author (GRA)

N72-13337# Stanford Research Inst., Menlo Park, Calif.
HIGH-LATITUDE AURORAL-RADAR AND HF-DOPPLER STUDIES OF GEOACOUSTIC PHENOMENA Final Report, 1 Jun. 1970 - 31 Jul. 1971
Edward J. Fremouw and Norman F. J. Chang Jul. 1971 128 p refs
(Contract F44620-70-C-0117; ARPA Order 1722; SRI Proj. 8706; AO Proj. 17-22)
(AD-729203; AFOSR-71-2330TR; Rept-62701D) Avail: NTIS CSCL 04/1

The document reports the results of a coordinated program of ionospheric observations pertaining to high-latitude geoacoustics research. The program consisted of two types of measurements, aimed respectively at study of Auroral Infrasonic Waves (AIW's) and Traveling Ionospheric Disturbances (TID's). Understanding these two phenomena is relevant to the problem of detecting and interpreting remote, man-made atmospheric pressure disturbances such as those that result from nuclear detonations.
Author (GRA)

N72-13338# Naval Postgraduate School, Monterey, Calif.
A STUDY OF MEAN MONTHLY THERMAL CONDITIONS AND INFERRED CURRENTS IN MONTEREY BAY M.S. Thesis
Lennis Larry Lammers Jun. 1971 164 p refs
(AD-728725) Avail: NTIS CSCL 08/10

Temperature data, collected over the past 40 years, was compiled and averaged in the first known study of mean thermal conditions throughout the waters of Monterey Bay.
Author (GRA)

N72-13339# Ohio State Univ., Columbus. Dept. of Geodetic Science.
A STUDY OF COVARIANCE FUNCTIONS RELATED TO THE EARTH'S DISTURBING POTENTIAL
Peter Meissl Apr. 1971 95 p refs
(Contract F19628-69-C-0127)
(AD-728688; DGS-151; SR-14; Task-7600-02; Task-04-01; DoD-Element-02101f; DoD-Subelement-681000) Avail: NTIS CSCL 08/5

Geoidal undulations, gravity anomalies, deflections of the vertical, a fictitious surface density, and the vertical gradient of gravity anomalies are considered. These quantities are interrelated by linear operators with spherical harmonics as eigenfunctions. If the covariance of one of these quantities is specified, the other covariances can be computed, and rigorous bounds for the ratios of the different variances can be established. Attention is focused on potentials obtained from a combination of satellite information and gravimetry. The introduced quantities are considered residuals with respect to a geoid resulting from the adjusted lower degree harmonic coefficients. The covariance of any one of the residual quantities tends to have a predetermined number of zeros as well as negative correlation at predetermined distances. A comparison was made between the gravity anomaly residuals with respect to a low order geoid and mean 5 deg x 5 deg block anomalies with uncorrelated errors. The resulting errors in geoidal undulations and deflections of the vertical are compared.
Author

N72-13340# Naval Undersea Research and Development Center, San Diego, Calif. Ocean Sciences Dept.
SOUND SPEED IN SEAWATER AS A FUNCTION OF REALISTIC TEMPERATURE-SALINITY-PRESSURE DOMAINS Technical Publication, Jul. 1969 - Oct. 1970
Ernest R. Anderson Aug. 1971 60 p refs
(Proj. SF11-552-101)
(AD-729001; NUC-TP-243; Task-0586; NUC-50021) Avail: NTIS CSCL 08/10

The Wilson (October 1960) sound-speed equation is widely used for computing seawater sound speeds as a function of temperature, salinity, and pressure. The internal consistency of the Wilson laboratory measurements of sound speed, from which the Wilson equation is derived, is examined. The reported salinity of three of the seawater samples used in making the laboratory measurements seems to be in error by amounts larger than the generally accepted salinity measurement error. Moreover, an analysis, for the real- and open-ocean temperature-salinity-pressure domains, of the average difference between the laboratory sound-speed measurements and the sound speeds computed using Wilson's (October) equation showed systematic biases over temperature, salinity, and depth intervals of importance to acoustic applications. A new 13-variable sound-speed equation, using a realistic oceanic temperature-salinity-pressure domain consisting of 344 sound-speed measurements and a stepwise regression technique to evaluate the constants, is presented. This equation removes all significant sound-speed gradient bias from computations based on Wilson's (October) equation for temperature-salinity-pressure triplets observed in the open ocean. Since most presently available sound-speed data has been obtained using the Wilson equation, a procedure for obtaining an average correction as a function of temperature, salinity, and depth is presented. The procedure stresses important corrections of biased sound-speed gradients.
GRA

N72-13341# Arizona Univ., Tucson.
PRELIMINARY RESULTS OF AN INFRARED SKY SURVEY Semiannual Technical Report
Frank J. Low 28 Feb. 1971 21 p refs
(Contract F19628-70-C-0046; ARPA Order 1366; AF Proj. 5130)
(AD-729214; AFCRL-71-0387; SATR-2) Avail: NTIS CSCL 03/2

Preliminary reports of a groundbased survey of the sky at 10 microns are reported. Four different detector systems have been used; their performance is discussed. On the basis of partial reduction of the data, one can state that the space density of stars at 10 microns is no greater than 0.01 per square degree at flux levels above 3.5 x 10 to the (-16) power w/sq.cm/micron. Extragalactic sources have been observed down to a flux limit of 3 x 10 to the (-19) power w/sq.cm/micron.

A celestial star chart and catalog is given for 100 stars brighter than 3 x 10 to the (-16) power w/sq.cm/micron. Author (GRA)

N72-13342# Bergen Univ. (Norway). Seismological Observatory.
CRUSTAL STRUCTURE IN SOUTHEASTERN NORWAY FROM SEISMIC REFRACTION MEASUREMENTS
Reidar Kanestroem and Kristen Haugland 30 Apr. 1971 76 p refs
(Contract F61052-68-C-0019; AF Proj. 8652)
(AD-729216; AFOSR-71-2314TR; SR-5) Avail: NTIS CSCL 08/7

A seismic refraction profile was carried out in Southeastern Norway in 1969 as a part of the Trans-Scandinavian Seismic Project. The explosions were also recorded at NORSAR. The data suggests a three layered crust with seismic velocities of 6.2, 6.55 and 7.1-7.3 km/sec. The upper mantle velocity of 8.20 km/sec agrees with values found previously in Scandinavia. The mean depths to the discontinuities within the crust were determined to be 17 and 26 km. The depth to the Moho discontinuity varies from about 32 km in the southern part of the profile to 41 km in the central part of the profile. Under NORSAR, the depth to Moho varied from 31.5 km in the central part to 38 km under the C-ring. A linear relationship can be observed between the depth of the mantle and the surface elevation and between the depth of the mantle and the Bouguer anomaly. The density contrast between the crust and mantle was determined to be 0.50 g/cu cm. Author (GRA)

N72-13779*# California Inst. of Tech., Pasadena.
THEORETICAL FRAMEWORKS FOR TESTING RELATIVISTIC GRAVITY: A REVIEW
Kip S. Thorne, Clifford M. Will, and Wei-Tou Ni *In* JPL Proc. of the Conf. on Exptl. Tests of Gravitation Theories 1 Nov. 1971 p 10-31 (See N72-13776 04-30)
(Grants NSF GP-19887; NSF-GP-27304)
Avail: NTIS CSCL 08N

N72-13780*# Montana State Univ., Bozeman.
TESTS OF THE EQUIVALENCE PRINCIPLE AND GRAVITATION THEORY USING SOLAR SYSTEM BODIES
Kenneth Nordtvedt, Jr. *In* JPL Proc. of the Conf. on Exptl. Tests of Gravitation Theories 1 Nov. 1971 p 32-37 refs (See N72-13776 04-30)
Avail: NTIS CSCL 03B

N72-13783*# Moscow State Univ. (USSR).
ON THE HETERODYNE METHOD OF DETECTING GRAVITATIONAL WAVES
V. B. Braginsky and V. S. Nazarenko *In* JPL Proc. of the Conf. on Exptl. Tests of Gravitation Theories 1 Nov. 1971 p 45-46 refs (See N72-13776 04-30)
Avail: NTIS CSCL 08N

N72-13784*# Stanislaus State Coll., Turlock, Calif.
OBSERVATIONS OF EARTH EIGEN VIBRATIONS POSSIBLY EXCITED BY LOW FREQUENCY GRAVITY WAVES
V. S. Tuman *In* JPL Proc. of the Conf. on Exptl. Tests of Gravitation Theories 1 Nov. 1971 p 47-53 refs (See N72-13776 04-30)
Avail: NTIS CSCL 08N

N72-13785*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
MEASUREMENT OF THE GRAVITATIONAL REDSHIFT USING A CLOCK IN AN ORBITING SATELLITE
R. F. C. Vessot (Harvard Coll. Obs.) and M. W. Levine (Harvard Coll. Obs.) *In* JPL Proc. of the Conf. on Exptl. Tests of Gravitation Theories 1 Nov. 1971 p 54-64 refs (See N72-13776 04-30)
(Contract nsr-09-015-098)
Avail: NTIS CSCL 03B

N72-13794*# Massachusetts Inst. of Tech., Cambridge.
TESTING GENERAL RELATIVITY: PROGRESS, PROBLEMS, AND PROSPECTS
Irwin I. Shapiro *In* JPL Proc. of the Conf. on Exptl. Tests of Gravitation Theories 1 Nov. 1971 p 136-147 refs (See N72-13776 04-30)
Avail: NTIS CSCL 08N

N72-13804*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
AN EOTVOS EXPERIMENT IN EARTH ORBIT
Philip K. Chapman (MIT) and Andrew J. Hanson (MIT) *In* JPL Proc. of the Conf. on Exptl. Tests of Gravitation Theories 1 Nov. 1971 p 228-235 refs (See N72-13776 04-30)
Avail: NTIS CSCL 03B

N72-13805*# European Space Research Organization, Paris (France).
ESRO STUDY PROGRAM FOR A SPACE EXPERIMENT ON GRAVITATION THEORIES
G. M. Israel *In* JPL Proc. of the Conf. on Exptl. Tests of Gravitation Theories 1 Nov. 1971 p 236-241 (See N72-13776 04-30)
Avail: NTIS CSCL 03B

N72-13815*# California Univ., Berkeley.
FEASIBILITY STUDY OF ADMIXTURE SOIL STABILIZATION WITH PHENOLIC RESINS
H. Turan Durgunoglu and James K. Mitchell *In its* Lunar Surface Eng. Properties Expt. Definition, Vol. 1 Jul. 1971 13 p refs (See N72-13811 04-30)
Avail: NTIS CSCL 08M

N72-13819*# California Univ., Berkeley.
AN EXPERIMENTAL STUDY OF THE MECHANISM OF FAILURE OF ROCKS UNDER BOREHOLE JACK LOADING
Tran K. Van and Richard E. Goodman *In its* Lunar Surface Eng. Properties Expt. Definition, Vol. 3 Jul. 1971 36 p refs (See N72-13817 04-30)
Avail: NTIS CSCL 08M

N72-13820*# California Univ., Berkeley.
A BOREHOLE JACK FOR DEFORMABILITY, STRENGTH, AND STRESS MEASUREMENTS IN A 2-INCH BOREHOLE
Richard E. Goodman, H. John Hovland, and Suphon Chirapuntu *in its* Lunar Surface Eng. Properties Expt. Definition, Vol. 3 Jul. 1971 28 p refs (See N72-13817 04-30)
Avail: NTIS CSCL 08M

N72-13951# Royal Swedish Academy of Engineering Sciences, Stockholm.
EARTH MAGNETIC FIELD AND CONTINENTIAL DRIFT
In its Develop. in Res. and Technol. during 1970 1970 p 81-84 refs In SWEDISH (See N72-13942 04-34)
Avail: NTIS; Almqvist & Wiksell, Stockholm: 25 Kr

N72-13956# Royal Swedish Academy of Engineering Sciences, Stockholm.
SWEDISH RESEARCH ON ENERGY AND ITS GLOBAL RELATIONSHIP
In its Develop. in Res. and Technol. during 1970 1970 p 116-150 refs In SWEDISH (See N72-13942 04-34)
Avail: NTIS; Almqvist & Wiksell, Stockholm: 25 Kr

14 INSTRUMENTATION AND PHOTOGRAPHY

Includes design, installation, and testing of instrumentation systems; gyroscopes; measuring instruments and gages; recorders; transducers; aerial photography; and telescopes and cameras.

N72-13343* National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
APOLLO MISSION 14 LUNAR PHOTOGRAPHY INDEXES
Jun. 1971 25 p
(NASA-TM-X-67457) Avail: NASA. Goddard Space Flight Center, Greenbelt, Md. SSDC CSCL 14E

Indexes for lunar photography from Apollo mission 14 are presented. The indexes represent 16 mm color photographs during lunar module ascent and descent, and sextant landmark tracking; 70 mm black and white landing site selection, stereo strip, zero phase, and orbital science photographs; 70 mm color orbital science photographs; and 5 inch black and white landing site selection photographs. K.P.D.

N72-13344 National Lending Library for Science and Technology, Boston Spa (England).
TELESCOPES IN ORBIT
12 Jul. 1971 3 p Transl. into ENGLISH of Izv. (Moscow), 21 May 1971
(NLL-M-20761-(5828.4F); NLL-117H8544/8) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

The advantages of extraterrestrial astronomy over traditional, earth-bound astronomy are considered. Difficulties and problems connected with placing astronomical equipment outside the terrestrial atmosphere are discussed. K.P.D.

N72-13345 National Lending Library for Science and Technology, Boston Spa (England).
ON THE HEATING OF ELECTRON MICROSCOPE OBJECTS WITH SMALL BEAM CROSS SECTION
S. Leisegang 22 Sep. 1971 9 p refs Transl. into ENGLISH from Proceedings of 3d Intern. Electron Microscope Conf., (London), 1954 p 176-184
(NLL-T-6940-(5809.95)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

The temperature of an object film was calculated using an extension of the theory of von Porries and Glaser, and was compared with measurements made on the electron microscope. A temperature of 320 C (melting point of lead) was reached (as calculated) in a graphitized film 400 A thick, with a beam of current density 5 amp/sq cm and a diameter of 18 microns. For a beam 6 microns in diameter the temperature would be 100 C. Author

N72-13346 National Lending Library for Science and Technology, Boston Spa (England).
NEW INSTRUMENTS FOR RADIATION MEASUREMENTS IN THE ATMOSPHERE
V. I. Sljahov, M. B. Fridzon, and V. I. Kurakin [1971] 7 p refs Transl. into ENGLISH from Glav. Uprav. Gidromet. Sluzh., Met. Gidr. (Leningrad), no. 8, 1970 p 84-89
(NLL-M-20845-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

A description is given of the instruments used to measure long wave radiation balance and effective radiation in the presence of solar radiation. A balance meter for measuring overall radiation balance is also described. Author

N72-13347# Electrotechnical Lab., Tokyo (Japan).
FOURIER SPECTROSCOPY
Morotake Nishi Dec. 1970 72 p refs In JAPANESE; ENGLISH summary
(Circ-169) Avail: NTIS

Fourier spectroscopy is a method recently developed for measuring the spectral radiant power. The method utilizes a two-beam interferometer, in which the optical path difference between the beams is gradually changed within certain limits, so that the spectral distribution of the incident radiation is modified with time, and this gives an interferogram as photodetector output. Then the spectral distribution of the incident radiation is calculated by the inverse Fourier transform of the interferogram with the aid of an electronic computer. Author

N72-13348*# Prescott College, Ariz. Dept. of Anthropology.
THE IDENTIFICATION OF ARCHAEOLOGICAL SITES BY FALSE COLOR INFRARED AERIAL PHOTOGRAPHY
George J. Gumerman May 1971 18 p refs
(NASA Order W-13265; Grant DI-14-08-0001-G-34)
(NASA-CR-124828; Task-160-75-01-32-10; USGS-211) Avail: NTIS CSCL 14E

The study of color infrared photography of Tehuacan Valley, Mexico was made to determine the applicability of remotely sensed data to archeology. Photography was interpreted without prior knowledge of the area, followed by a field check to determine accuracy of the original interpretations and to evaluate causes of successes and failures. Results indicate that the visibility of sites depends primarily on its environmental situation, and also that the delineation of environents and microenvironments is especially easy with this type of film. Furthermore, the age and size of the sites are not necessarily the deciding factors in their discernment. Author

N72-13349# Royal Aircraft Establishment, Farnborough (England).
SEMIAUTOMATIC EXPERIMENTAL APPARATUS FOR STUDYING THE PERIPHERAL FIELD OF VISION
V. I. Butov Apr. 1971 15 p Transl. into ENGLISH from Vopr. Psikhologii (USSR), v. 1, 1967 p 160-165
(RAE-Lib-Trans-1558; UDC-612.84:159.931; BR27094) Avail: NTIS

The apparatus described consists of a modified projection perimeter producing a movable light spot along the arc of the perimeter. A central task is also incorporated which requires the subject to process foveally presented digital information, while simultaneously detecting the peripherally presented light spots. An automatic timing program is an integral part of the apparatus which has the facility of allowing the subject to set for himself the rate of presentation of the digital information. A circuit diagram and detailed method of operation of the equipment is also included. Author

N72-13350# Nagoya Univ. (Japan). Inst. of Plasma Physics.
ANALYSIS OF MICROWAVE INTERFEROMETER FOR PLASMA DENSITY MEASUREMENT
Chiyo Kuwahara, Kiyotake Matsuura, and Akira Miyahara Mar. 1971 35 p refs
(IPPJ-107) Avail: NTIS

A phase shift measurement of a microwave interferometer was analysed by introducing a 'two vector' model. An error due to unbalance and mismatching in the circuit was calculated by considering an attenuation of a transmitted wave and to verify the theoretical analysis a simulation experiment was made. Author

N72-13351*# Transportation Systems Center, Cambridge, Mass.
LABORATORY EVALUATION OF FECKER AND LORAL OPTICAL IR PWI SYSTEMS
Mark Gorstein, James N. Hallock, Maurice Houten, and Ian G. McWilliams Feb. 1971 83 p ref
(NASA Order-R1022)
(NASA-CR-124721; DOT-TSC-NASA-71-5) Avail: NTIS CSCL 14B

A previous flight test of two electro-optical pilot warning indicators, using a flashing xenon strobe and silicon detectors as cooperative elements, pointed out several design deficiencies. The present laboratory evaluation program corrected these faults and calibrated the sensitivity of both systems in azimuth elevation and range. The laboratory tests were performed on an optical bench and consisted of three basic components: (1) a xenon strobe lamp whose output is monitored at the indicator detector to give pulse to pulse information on energy content at the receiver; (2) a strobe light attenuating optical system which is calibrated photometrically to provide simulated range; and (3) a positioning table on which the indicator system under study is mounted and which provides spatial location coordinates for all data points. The test results for both systems are tabulated.
D.L.G.

N72-13352*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
LIQUID-FILLED TRANSIENT PRESSURE MEASURING SYSTEMS: A METHOD FOR DETERMINING FREQUENCY RESPONSE
Robert C. Anderson and David R. Englund, Jr. Washington Dec. 1971 27 p refs
(NASA-TN-D-6603; E-6422) Avail: NTIS CSCL 14B

An equation is given and experimentally verified for computing the resonant frequency of liquid-filled transient pressure measuring systems. Resonant frequencies of 100 to 1000 Hz are typical of those systems tested. The effect of noncondensable gas bubbles on system response is described. A method for determining transducer volumetric compliance is presented. An example system is described and analyzed to demonstrate the use of the theory. Author

N72-13353# Indian Inst. of Tech., Kanpur. Dept. of Aeronautical Engineering.
IMPROVED PRESENTATION OF PRESTON TUBE CALIBRATION
M. R. Head and V. Vasanta Ram 1970 11 p refs
(AE-10/1970) Avail: NTIS

Results of Patel's Calibration of the Preston tube are presented in two alternative forms that are better suited for direct use. The methods of presentation are: (1) delta p/tau sub w vs delta pd(2) in the form of tables; and (2) u sub p/U vs Ud/nu with the skin-friction coefficient c sub f as parameter.
Author

N72-13354*# California Univ., Berkeley. Space Sciences Lab.
FABRICATION AND EVALUATION OF LARGE-AREA ULTRASOFT X-RAY DETECTORS SUITABLE FOR SPACECRAFT APPLICATION Final Report
S. Bowyer 1 Oct. 1971 27 p
(Contract NAS9-11024)
(NASA-CR-115265) Avail: NTIS CSCL 14B

The modifications to the Houston/MSC design of the gas proportional counter flight electronics system are discussed. The following modifications are described: charge amplifier bandwidth improvements, power converter redesign, serial data output buffer, second differentiator, and risetime discriminator. In addition, the redesign of the stellar aspect camera is discussed along with developments in thin film fabrication. F.O.S.

N72-13355*# Pennsylvania State Univ., University Park. Ionosphere Research Lab.
INTEGRATED CIRCUIT ELECTROMETER AND SWEEP CIRCUITRY FOR AN ATMOSPHERIC PROBE
Larry Eugene Zimmerman 1 Nov. 1971 41 p refs
(Grant NGL-39-009-015)
(NASA-CR-124796; PSU-IRL-SCI-376(E)) Avail: NTIS CSCL 14B

The design of electrometer circuitry using an integrated circuit operational amplifier with a MOSFET input is described. Input protection against static voltages is provided by a dual ultra low leakage diode or a neon lamp. Factors affecting frequency response leakage resistance, and current stability are discussed, and methods are suggested for increasing response speed and for eliminating leakage resistance and current instabilities. Based on the above, two practical circuits, one having a linear response and the other a logarithmic response, were designed and evaluated experimentally. The design of a sweep circuit to implement mobility measurements using atmospheric probes is presented. A triangular voltage waveform is generated and shaped to contain a step in voltage from zero volts in both positive and negative directions. Author

N72-13356*# Massachusetts Inst. of Tech., Cambridge. Charles Stark Draper Lab.
A TRAVERSE GRAVIMETER FOR THE LUNAR SURFACE
Glenn Mamon Aug. 1971 36 p ref Presented at Inst. of Elec. and Electron. Engr. Geosci. Electron. Symp., Washington, D. C., 25 Aug. 1971
(Contract NAS9-11155; DSR Proj. 55-45120)
(NASA-CR-115263; E-2603) Avail: NTIS CSCL 14B

A semi-automatic, self-levelling lunar gravimeter was designed for the purpose of measuring gravity at predetermined stops along the route of a lunar rover vehicle to obtain a gravity profile. The traverse gravimeter is completely self-contained and is powered by an internal battery. The gravity sensor is a vibrating string accelerometer (VSA) which is enclosed in a precision oven. Gravity data are obtained by initiating a measurement. After the gravimeter has levelled, the VSA difference frequency is counted down and a gate is generated to enable a crystal-controlled clock to a BCD counter. The BCD counter stores the data which are a measurement of gravity. These data, displayed upon command by the astronaut, are transmitted by voice back to earth. It is expected that the accuracy of the gravimeter will be better than one milligal. Low power, light weight, reliability, and simplicity of operation are major considerations in the design of the gravimeter. Author

N72-13357*# National Bureau of Standards, Boulder, Colo.
HYDROGEN SLUSH DENSITY REFERENCE SYSTEM Final Report
D. H. Weitzel, L. T. Lowe, D. A. Ellerbruch, J. E. Cruz, and C. F. Sindt 30 Jun. 1971 83 p refs
(NASA Order H-2159a)
(NASA-CR-124764; NBS-9796) Avail: NTIS CSCL 14B

A hydrogen slush density reference system was designed for calibration of field-type instruments and/or transfer standards. The device is based on the buoyancy principle of Archimedes. The solids are weighed in a low-mass container so arranged that solids and container are buoyed by triple-point liquid hydrogen during the weighing process. Several types of hydrogen slush density transducers were developed and tested for possible use as transfer standards. The most successful transducers found were those which depend on change in dielectric constant, after which the Clausius-Mossotti function is used to relate dielectric constant and density. Author

N72-13358# Japan Broadcasting Corp., Tokyo.
THE TELEVISION FACSIMILE SYSTEM
Sueyoshi Soejina Oct. 1971 13 p refs
(NHK-Labs-Note-136) Avail: NTIS

The methods used to investigate the feasibility of facsimile broadcasting by multiplexing television signals are discussed. Particular attention was given to an experiment involving facsimile transmission multiplexed on the vertical blanking interval of a standard television picture. The experiment was performed over WNBC-television in New York from June through November 1967. Test results indicate that specifications for program selecting signals and specifications directly related to the transmission system should be determined. E.H.W.

N72-13359# Japan Broadcasting Corp., Tokyo. Advanced Television System Research Group.
A COLORIMETRIC MEASURING INSTRUMENT FOR

COLOR TELEVISION CAMERAS
Toshiya Saito Dec. 1970 15 p refs
(NHK-Labs-Note-137) Avail: NTIS

A colorimetric measuring instrument was developed, which consists of a channel scanner, a picture element pointer, a sample holder, an A-D converter and a small computer. This instrument can automatically estimate the colorimetric distortion caused by a camera with reasonable precision, and quick enough for the estimation to be applied to succeeding improvement tests. Author

N72-13360# Japan Broadcasting Corp., Tokyo. Technical Research Labs.
THE NHK HELICOPTER COLOR CAMERA
Sakae Shigeta, Kotaro Wakui, Masao Sugimoto, and Heiichiro Ando Mar. 1971 15 p
(NHK-Labs-Note-142) Avail: NTIS

A description is given of a helicopter color camera system. This system can be used not only on a helicopter, but automobiles, too, with easy operation and a good quality color picture. Its distinctive features include a wireless color camera system with newly designed equipment such as a 3 plumbicon-tube color camera, digital control equipment, an 800MHz video transmitter and receiver, and a vibration isolator. Author

N72-13361# British Petroleum Co., Ltd., Sunbury-on-Thames (England). Research Centre.
A MODIFICATION TO INCREASE THE INTENSITY OF RECORDED SPECTRA FROM THE AEI MS9 MASS SPECTROMETER
W. L. Mead 15 Apr. 1971 9 p refs
(Proj. 201)
(TM-110-196) Avail: NTIS

A simple electronic modification to the MS9 mass spectrometer is described that permits the recording of mass spectral peaks amplified by up to a factor of ten as compared to the unmodified instrument. The modification is particularly advantageous for recording the overall weak spectra that sometimes occur with the use of the field ionization technique. Author

N72-13362*# Boeing Co., New Orleans, La. Space Div.
BORESCOPE WITH VARIABLE ANGLE SCOPE Patent Application
Drury K. Mitchell, inventor (to NASA) Filed 22 Dec. 1970 17 p
(Contract NAS8-5608)
(NASA-Case-MFS-15162; US-Patent-Appl-SN-100639) Avail: NTIS CSCL 14B

A borescope with an adjustable hinge telescoping optical system is described. The device consists of a straight tubular barrel with an operator viewing eyepiece on one end, and a telescoping head assembly on the other. An adjustable hinged portion can be inserted between the head assembly and the tubular barrel to position the head assembly through a sharp bend in the pipe. The telescoping head carries a mirror and illumination means so that an operator looking through the eyepiece can view the interior side walls of the bore. NASA

N72-13363*# Block Engineering, Inc., Cambridge, Mass.
HIGH RESOLUTION FOURIER TRANSFORM SPECTROMETER SERIAL NO. 091002: INSTRUCTION MANUAL Final report.
Sep. 1971 117 p
(Contract NAS9-9807)
(NASA-CR-125218) Avail: NTIS CSCL 14B

A description of the spectrometer and procedures for its operation, maintenance, alignments, adjustments, and control functions are presented. The interferometer spectrometer is a modified Model 296 capable of 0.5/cm resolution over the spectral region of 5 to 15 microns configured for operation with the optical head at a temperature of approximately 80 K. Details are given on the optical system and the electronic circuits. The detector used with the optical head is mercury doped germanium kept at a temperature of about 4 K by means of liquid helium. Electronic schematics, and instruction manuals for handling the liquid helium dewars, tape recorder for analog outputs, and playback console are included. N.E.N.

N72-13364# Joint Publications Research Service, Washington, D.C.
AIRBORNE AND SATELLITE IR SOUNDING
10 Dec. 1971 19 p refs Transl. into ENGLISH from Opt.-Mekh. Prom. (Leningrad), no. 3, 1971 p 3-9 and Lesn. Khoz. (Moscow), no. 5, 1971 p 60-64
(JPRS-54671; UDC-621.384.326.22:528.7) Avail: NTIS

Results of experimental studies conducted in 1967 demonstrated the high potentiality involved in utilizing infrared scanning equipment for various natural-scientific reasons. The data presented indicate the necessity of the most rapid adoption of infrared aerial photography in the national economy. Author

N72-13365*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
LUNAR-SURFACE CLOSEUP STEREOSCOPIC PHOTOGRAPHY ON THE SEA OF TRANQUILITY (APOLLO 11 LANDING SITE)
W. R. Greenwood, R. L. Jones, G. H. Heiken, Merritt Bender, and Robert O. Hill Dec. 1971 23 p ref
(NASA-TM-X-58077) Avail: NTIS CSCL 14E

Analysis of returned lunar samples provides limited information about lunar geology. To obtain information about in-place lunar material, a closeup stereoscopic camera capable of photographing small-scale surface features was built and was used at the Apollo 11 landing site. Stereoscopic photographs were taken of surface areas relative to the lunar module, and the surfaces photographed were analyzed. The photographs are classified into five groups: soil disturbed by astronaut activities, generally undisturbed soil, loose aggregate surface material, crater bottoms with prominent glass deposits, and hard rock deposits. Glass deposits in the returned samples are described for comparison with the features observed in the photographs. The stereoscopic photographs were of outstanding quality and show the nature of lunar-surface material in detail. Lunar topography was reconstructed from the photographs with an analytical plotter. The photography results indicate that the closeup composition and genesis of lunar soil at the Apollo 11 landing site. Author

N72-13366*# IIT Research Inst., Chicago, Ill.
DEVELOPMENT OF A POSITION SENSITIVE X-RAY DETECTOR FOR USE IN A LIGHT WEIGHT X-RAY DIFFRACTOMETER Final Report, 1 Aug. 1970 - 31 Jul. 1971
R. A. Semmler Jul. 1971 60 p refs
(Contract NASw-2111)
(NASA-CR-124810; IITRI-V6112-4) Avail: NTIS CSCL 14B

A position sensitive proportional counter for use in an X-ray diffractometer is developed to permit drastic reductions in the power and weight requirements of the X-ray source and the elimination of the power, weight, and complexity of a moving slit. The final detector constructed and tested has a window spanning 138 and a free standing anode curved along an arc of 7.1 cm radius. Demonstration spectra of a quartz sample in a Debye-Sherrer geometry indicate a spatial resolution of 0.4 - 0.5 mm (0.3 - 0.4 theta). The lunar diffractometer consumed 25 watts in the X-ray generator and weighed about 20 pounds. Author

N72-13367# Weapons Research Establishment, Salisbury (Australia).
CONCISE METHOD FOR PHOTOGRAMMETRY OF OBJECTS IN THE SKY

K. H. Lloyd Aug. 1971 54 p refs
(WRE-TN-72) Avail: NTIS

A concise method for triangulating the position of objects in the sky is presented. It follows the standard methods of triangulation, using photographs of the object against a star background. A computer program is described which was developed specifically for the analysis of chemical releases, but which may be used quite generally. The program can be applied to point objects, linear objects, or sinuous trails. The program, IG2-14-11, is written in FORTRAN 2 for the IBM 7090 computer. Author

N72-13368*# National Bureau of Standards, Washington, D.C.
METHODS OF MEASUREMENT FOR SEMICONDUCTOR MATERIALS, PROCESS CONTROL, AND DEVICES Quarterly Report, 1 Apr. - 3 Jun. 1971
W. Murray Bullis, ed. Dec. 1971 45 p refs Sponsored jointly by DASA, Navy, AF, ARPA, NASA, and AEC
(NASA Order S-70003-G; NASA Order H-76553A)
(NASA-CR-124836; NBS-TN-702) Avail: NTIS; SOD $.50 as C-13.46:702 CSCL 14B

The development of methods of measurement for semiconductor materials, process control, and devices is discussed. The following subjects are also presented: (1) demonstration of the high sensitivity of the infrared response technique by the identification of gold in a germanium diode, (2) verification that transient thermal response is significantly more sensitive to the presence of voids in die attachment than steady-state thermal resistance, and (3) development of equipment for determining susceptibility of transistors to hot spot formation by the current-gain technique. P.N.F.

N72-13369# National Oceanic and Atmospheric Administration, Rockville, Md. Center for Experiment Design and Data Analysis.
HIGH LEVEL CLOUD PHOTOGRAPHY INVENTORY BOMEX PERIOD 1, 3-15 MAY 1969
Vance A. Myers Dec. 1971 57 p refs
(NOAA-TM-ERL-BOMAP-7) Avail: NTIS

The high-level loud photography missions flown by RB-57F aircraft during the first period of Barbados Oceanographic and Meteorological Experiment (BOMEX), 3 to 15 May, 1969, are documented. Tables and flight tracks give the time and location of each of the photographs taken. Author

N72-13370*# Scientific Translation Service, Santa Barbara, Calif.
THE STUDY AND CALIBRATION OF PRESSURE TRANSDUCERS IN PARTICULAR ENVIRONMENTS
B. Baerd, A. Julienne, and R. Nantois Washington NASA Dec. 1971 6 p refs Transl. into ENGLISH from Etude et Etalonnage de Capteurs de Pressions en Ambiances Particuliers, ONERA, report ONERA-TP-982, 1971 p 757-1-757-4 Presented at 7th Intern. Congr. on Acoustics, Budapest, 18-26 Aug. 1971
(Contract NASw-2035)
(NASA-TT-F-14090; ONERA-TP-982) Avail: NTIS CSCL 14B

The design concepts and calibration of unsteady pressure transducers are described. These transducers must operate under difficult conditions, such as at high pressure levels, high flow rates, high static overpressures, high vibration rates, and high temperatures. The studies were carried out in connection with the investigation bf noise having aerodynamic origin. Author

N72-13371*# Scientific Translation Service, Santa Barbara, Calif.
STUDY OF THE DISTORTION OF PLATES OBTAINED WITH ELECTRONIC CAMERA
M. Duchesne, M. Feissel, and B. Guinot Washington NASA Dec. 1971 44 p refs Transl. into ENGLISH from Etude de la Distorsion des Cliches Obtenus avec la Camera Electronitronique, Observatorie de Paris, Notes et Informations, part 26, Astrophysique no. 7, May 1965 p 1-28
(Contract NASw-2035)
(NASA-TT-F-14067) Avail: NTIS CSCL 14E

The radial velocity of Mercury was measured, using an optical method to derive the astronomical unit in meters. Optical characteristics were determined for the system used for data reduction, in which special photographic plates were employed. Author

N72-13372# Sandia Corp., Albuquerque, N.Mex.
RADIAL DEFORMATION ANALYSIS BY HOLOGRAPHIC INTERFEROMETRY
C. G. Murphy, O. J Burchett, and C. W. Matthews Apr. 1971 43 p refs Sponsored by AEC
(SC-DR-71-0036) Avail: NTIS

An expression for determining the radial deformation of cylinders under hoop tension by the use of double exposure holographic interferometry was developed. The analysis of the holographic fringe system is performed in two ways. First, an extremely simple form is found for application at the cylinder viewing angle where the maximum fringe order occurs. This simple analysis gives good results from a count of the maximum fringe order and a simple slide rule calculation. No determination of the angle of the maximum order is necessary from the fringe system since this angle can be found a priori. The second application of the radial deformation expression is a calculation which uses the position of dark fringes to find the deformation over the whole of the illuminated region of the cylinder. This analysis is accurate over about two-thirds of the illuminated region. A computer program is given for this analysis of the illuminated region with corrections which extend the accuracy of the method. Author

N72-13373# Gosudarstvennyi Komitet po Ispolzovaniyu Atomnoi Energii, Serpukhov (USSR). Institut Fiziki Vysokikh Energit.
SHAPING DEVICES FOR GRATING AND TRACK SIGNALS
V. E. Ivchenko, A. A. Ivanov, and G. N. Khromova 1970 14 p refs In RUSSIAN
(IFVE-SPK-70-59) Avail: AEC Depository Libraries

Devices used in systems for measuring tracks on chamber pictures are described. These devices shape signals from photomultipliers of film and grating channels. Principal schemes of the devices are given. Some improvements for increasing the resolution and accuracy to separate signals from the photomultipliers are realized. Author (NSA)

N72-13374# Danish Meteorological Inst., Charlottenlund.
LONG TERM STABILITY OF A FERRITE CORE FLUXGATE MAGNETOMETER IN HIGH FIELD
F. Primdahl and W. R. Darker (Dept. of Energy Mines and Resources) 1971 11 p refs Sponsored jointly by Natl. Res. Council of Can., Can. Govt., and Danish Govt.
(R-25) Avail: NTIS

A 9 months comparison was made between a single component fluxgate and a proton magnetometer to investigate its stability in high magnetic fields (58,600 gamma). The fluxgate sensor was oriented parallel to the total field so that the output was directly comparable to a proton magnetometer reading. During the period the total drift of the fluxgate magnetometer was +35 gamma, which makes it well suited for use as a variometer. The electric output signal from the fluxgate makes it superior for data processing applications. ESRO

N72-13375# Aerospace Corp., El Segundo, Calif. Plasma Research Lab.
AN X-RAY PINHOLE CAMERA WITH NANOSECOND RESOLUTION
Melvin J. Bernstein and Frank Hai 1 Aug. 1971 21 p refs
(Contract F04701-71-C-0172)
(AD-728206; TR-0172(2220-20)-2; SAMSO-TR-71-143) Avail: NTIS CSCL 14/5

A pinhole camera system giving time-resolved photographs of the X-ray source in an intense plasma discharge is described. Each pinhole projected an image of the X-ray source onto a

sheet of scintillation plastic that converted the X-rays into a visible light image that was photographed with an image-converter camera. Use of twin pinholes with appropriate filters and scintillator thicknesses provided some spectral resolution. A spatial resolution of 2 mm was achieved with a time resolution of 10 nsec. Author (GRA)

N72-13376# Rome Air Development Center, Griffiss AFB, N.Y.
COMPARISON OF ZOOM MAGNIFICATION VS DISCRETE MAGNIFICATION FOR TARGET SCANNING TASKS Technical Report, Oct. 1970 - Jul. 1971
Daniel A. Ventimiglia Jul. 1971 47 p
(Job Order 69DB0000)
(AD-728646; RADC-TR-71-161) Avail: NTIS CSCL 14/5

The report describes the test and evaluation of zoom magnification versus discrete magnification for target scanning tasks on a rear projection viewer surface. The magnification range tested was 3X to 75X. The discrete selections were 3X, 6X, 12X, 18X, 30X, 50X, and 75X. The results are discussed for significant differences between magnification modes for plotted and unplotted targets in terms of time, accuracy, and completeness measures. Frequency of magnification change is significant for plotted targets. Also, some significant differences have been noted between scales for plotted and unplotted targets. Author (GRA)

N72-13377# Naval Academy, Annapolis, Md.
THE APPLICATION OF INTEGRATED CIRCUITS TO ELECTRONIC MEASUREMENT
William A. Emslie 18 May 1971 69 p refs
(AD-728764; USNA-TSPR-15) Avail: NTIS CSCL 14/2

The design for a High-Q Tunable Active Filter was incorporated into a Time Delay Measuring Device which was constructed to measure the time difference in a wave front incident with the array. In addition to the High-Q Tunable Active Filter, the Time Delay Measuring Device included also a Variable Time Delay, and an Analog Summing Amplifier both of which were used in the design of nulling circuits. Integrated circuit operational amplifiers were used throughout the design of the Time Delay Measuring Device. The advantages gained in performance, cost, reliability, and size reduction over the use of discrete components was clearly demonstrated. Author (GRA)

N72-13378# Army Foreign Science and Technology Center, Charlottesville, Va.
NEW PHASED ELECTRO-OPTICAL KDG-3 RANGE FINDER WITH SEMICONDUCTING OUTPUT SOURCE
L. A. Neverov, N. V. Kortev, T. A. Larionova, V. V. Mitrofanov, A. K. Milashveskii, Yu. V. Popov, and B. V. Ryzhenko 21 Jul. 1971 13 p refs Transl. into ENGLISH from Optiko-Mekh. Prom. (Leningrad), v. 37, no. 9, 1970 p 35-39
(AD-728230; FSTC-HT-23-803-71; T702301-2301) Avail: NTIS CSCL 17/8

The operating principle, optical network, construction, and results of tests are described for the first commercial electro-optical range finder with a gallium-arsenide diode output source. The apparatus allows measurements up to two km with less than 15 mm error over its entire range, while using at most five watts. Author (GRA)

N72-13379# Army Foreign Science and Technology Center, Charlottesville, Va.
A METHOD OF MEASURING THE SPEED OF THE STARTING MECHANISM OF A SYSTEM PHOTOGRAPHING
V. N. Gadion 30 Jun. 1971 11 p refs Transl. into ENGLISH from Zh. Nauchn. i Prikl. Fotogr. i Kinematogr. (Moscow), v. 15, no. 4, 1970 6 p
(AD-728152; FSTC-HT-23-995-71; T702301-2301) Avail: NTIS CSCL 14/5

A method of photographing the flow of models in free flight is discussed. Types of interference (from luminescence, extraneous light sources, etc.) and their remedies are described. The stability of the system depends on the starting apparatus of the photographing system. GRA

N72-13380# Army Weapons Command, Rock Island, Ill.
INSTRUMENTATION AND TECHNIQUES FOR INFRARED NONDESTRUCTIVE TESTING APPLICATIONS
George E. VanDamme, Michael J. Amoruso, and James W. McGarvey Jun. 1971 29 p refs
(AD-728812; AMSWE-RE-71-38) Avail: NTIS CSCL 14/2

Infrared nondestructive testing (IRNDT) techniques and instrumentation were used to successfully detect surface and near-surface flaws in circular and flat aluminum samples. A continuous wave CO2 laser was employed to inject large amounts of thermal energy into appropriate specimens. The surface of each specimen was scanned with an infrared radiometer to detect surface thermal anomalies that are indicative of surface and near-surface flaws. In addition, a miniaturized, high-speed, scanning infrared radiometer was designed and constructed for the inspection of the interior surfaces of large gun tubes and recoil cylinders (75mm or larger). The instrumentation and the techniques developed are anticipated to have wide application to many problems, such as the detection of cracks, voids, and inclusions in gun tubes, projectiles, recoil mechanisms, and aircraft components. Author (GRA)

N72-13381# Picatinny Arsenal, Dover, N.J.
INSTRUMENTED IMPACT TESTER OPERATION PROCEDURE FOR IZOD SPECIMEN
Dale E. Martin May 1971 19 p
(DA Proj. 1M2-62302-A-211)
(AD-728805; PA-TM-2006; AMCMS-Code-5222.11.58500) Avail: NTIS CSCL 14/2

A procedure was developed using instrumented Izod (cantilever beam) Impact Tester. This procedure can be used for testing various types of material such as: plastics, light metals, ceramics, and materials used in the non-metallic cartridge cases. There are two hammers available at present: A two foot pound, and 10 foot pound. The height of release of the pendulum is two feet, giving a striking velocity of approximately eleven foot pound seconds. An oscilloscope with storage display is used to record the results. Author (GRA)

N72-13382# Army Foreign Science and Technology Center, Charlottesville, Va.
EVALUATION OF ACCELEROMETER CALIBRATION ERROR WITH A CENTRIFUGE
G. A. Smirnov 30 Jun. 1971 11 p Transl. into ENGLISH from Tr. Politekhn. Inst. (Leningrad), no. 309, 1969 p 32-36
(AD-728153; FSTC-HT-23-1018-71) Avail: NTIS CSCL 14/2

Experimental evaluation of the accelerometer error, using the centrifuge, is described. Parameters describing the accuracy of the method as a function of the precision of centrifuge construction are discussed. GRA

N72-13383# General Electric Co., Schenectady, N.Y.
UNIT RECORD CARD GRAPHIC TECHNIQUES Semiannual Technical Report, 1 Dec. 1970 - 31 May 1971
John E. Bigelow and Siegfried Aftergut Aug. 1971 35 p refs
(Contract DAAB07-71-C-0073; DA Proj. 1H6-62701-A-484)
(AD-728500; S-71-1076; ECOM-0073-1; SATR-1) Avail: NTIS CSCL 14/5

Work during the first six months of an 18-month program to develop graphical techniques for a unit record card based on photoplastic film is described. The unit record card will ultimately permit a combination of machine-readable characters, man-readable characters, and high-density graphic material (such as engineering drawings and photographs) to be readily stored on and retrieved from a 3-inch by 5-inch card. Photoplastic film is a photoconductive, thermoplastic, recording film which permits rapid dry development, add-on capability, and reuse. The work includes efforts to optimize film performance at 220 cycles per millimeter with about half the desired deformation amplitudes

obtained thus far. Also described are the design and tests with an Electrofax copy maker of a special recorder/processor/projector unit. Author (GRA)

N72-13384# Miami Univ., Coral Gables, Fla. Dept. of Physics.
THE HOMIN, A HOLOGRAPHIC MULTIPASS INTERFEROMETER
J. G. Hirschberg, W. R McCluney, L. R. Hazelton, Jr., and A. K. Aggarwal (Indian Inst. of Tech., New Delhi) 1970 6 p refs Presented at Intern. Symp. of Holography, Besancon, France, 6-11 Jul. 1970
(Grant AF-AFOSR-1496-68; AF Proj. 9767)
(AD-728341; AFOSR-71-2260-TR) Avail: NTIS CSCL 20/6

A multiple pass two-beam optical interferometer has been constructed with ten times the sensitivity of a single pass instrument such as the Mach-Zehnder. Typical applications include measurements of optical density in a gas or plasma sample, and determinations of small changes in figure of optical elements. Double exposure holography is employed to relax the component requirements. Advantages of the new method are high sensitivity, adaptability to large test regions at low cost, and direct quantitative measurement. Author (GRA)

N72-13385# Army Cold Regions Research and Engineering Lab., Hanover, N.H.
AN ANALYSIS OF NONDESTRUCTIVE SENSING OF WATER CONTENT BY MICROWAVES
Pieter Hoekstra and Patrick Cappillino Jul. 1971 23 p refs
(DA Proj. 4A0-61101-A-91-D-03)
(AD-728831; CRREL-RR-295) Avail: NTIS CSCL 14/2

Microwave instrumentation is used for nondestructive measurement of the water content of materials. The basis of all microwave moisture sensors is that the dielectric constants of material that contains water are a strong function of water content. The microwave moisture sensors based on a reflection or transmission principle are shown to have the disadvantage of requiring that a calibration be made for each sample thickness. Several alternative routes for developing reliable microwave moisture sensors are discussed. Author (GRA)

N72-13781*# Louisiana State Univ., Baton Rouge.
A LOW TEMPERATURE GRAVITATIONAL RADIATION DETECTOR
William O. Hamilton *In* JPL Proc. of the Conf. on Exptl. Tests of Gravitation Theories 1 Nov. 1971 p 38-40 (See N72-13776 04-30)
Avail: NTIS CSCL 14B

N72-13782*# Rochester Univ., N.Y.
PROPERTIES OF HOLLOW SQUARE GRAVITATIONAL WAVE DETECTORS
D. H. Douglass, Jr. *In* JPL Proc. of the Conf. on Exptl. Tests of Gravitation Theories 1 Nov. 1971 p 41-44 refs (See N72-13776 04-30)
Avail: NTIS CSCL 14B

N72-13787*# Stanford Univ., Calif.
THE STANFORD GYROSCOPE EXPERIMENT
C. W. F. Everitt *In* JPL Proc. of the Conf. on Exptl. Tests of Gravitation Theories 1 Nov. 1971 p 68-81 refs (See N72-13776 04-30)
(Grant NGR-05-020-019)
Avail: NTIS CSCL 14B

N72-13788*# Louisiana State Univ., Baton Rouge.
GYROSCOPE TEST OF GRAVITATION: AN ANALYSIS OF THE IMPORTANT PERTURBATIONS
R. F. OConnell *In* JPL Proc. of the Conf. on Exptl. Tests of Gravitation Theories 1 Nov. 1971 p 82-84 refs (See N72-13776 04-30)
Avail: NTIS CSCL 14B

N72-13801*# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
PHYSICAL LIMITATIONS IN SENSORS FOR A DRAG-FREE DEEP SPACE PROBE
Remy Juillerat *In* JPL Proc. of the Conf. on Exptl. Tests of Gravitation Theories 1 Nov. 1971 p 197-212 refs (See N72-13776 04-30)
Avail: NTIS CSCL 14B

N72-13548*# Wisconsin Univ., Madison.
ACCURATE PULSE RADAR ALTIMETER FOR METEOROLOGICAL BALLOONS
Nadav Levanon and Ferrel Stremler *In its* Meteorol. Meas. from Satellite Platforms Aug. 1971 p 54-57 refs (See N72-13544 04-20)
Avail: NTIS CSCL 14B

N72-13549*# Wisconsin Univ., Madison.
IMAGE CORRELATOR FOR CLOUD DISPLACEMENT MEASUREMENT
J. G. Miller *In its* Meteorol. Meas. from Satellite Platforms Aug. 1971 p 58-68 ref (See N72-13544 04-20)
Avail: NTIS CSCL 14B

N72-13556*# Wisconsin Univ., Madison.
APPLICATION OF SIMULTANEOUS INFRARED RADIATION MEASUREMENTS AND CLOUD PHOTOGRAPHS FROM SATELLITES
Thomas H. VonderHaar *In its* Meteorol. Meas. from Satellite Platforms Aug. 1971 p 175-180 refs (See N72-13544 04-20)
Avail: NTIS CSCL 14E

N72-13393*# Naval Weapons Center, China Lake, Calif.
DYNAMIC BEHAVIOR OF THE MERCURY DAMPER
Prescott D. Crout (MIT) and Horace L. Newkirk *In* NASA. Goddard Space Flight Center 5th Aerospace Mech. Symp. 1971 p 9-16 refs This paper is based on reports NAVWEPS-8611 and NOTS-TP-3635 (See N72-13391 04-15)
Avail: NTIS CSCL 14B

N72-13396*# Maryland Univ., College Park. Dept. of Mechanical Engineering.
RESPONSE CHARACTERISTICS OF A THERMAL-HELIOTROPE SOLAR-ARRAY ORIENTATION DEVICE
Frederick H. Morse *In* NASA. Goddard Space Flight Center 5th Aerospace Mech. Symp. 1971 p 33-39 refs (See N72-13391 04-15)
Avail: NTIS CSCL 14B

N72-13398*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
DAMPER DESIGN FROM A STRUCTURAL ENGINEER'S POINT OF VIEW
Jay C. Chen *In* NASA. Goddard Space Flight Center 5th Aerospace Mech. Symp. 1971 p 59-64 ref (See N72-13391 04-15)
Avail: NTIS CSCL 13I

N72-13400*# Lockheed Missiles and Space Co., Palo Alto, Calif.
INTRODUCTION TO PASSIVE NUTATION DAMPERS
George C. Herzl *In* NASA. Goddard Space Flight Center 5th Aerospace Mech. Symp. 1971 p 73-81 refs (See N72-13391 04-15)
Avail: NTIS CSCL 13I

N72-13402*# Ball Bros. Research Corp., Boulder, Colo.
NUTATION-DAMPER DESIGN FOR DUAL-SPIN SPACECRAFT
Thomas M. Spencer *In* NASA. Goddard Space Flight Center 5th Aerospace Mech. Symp. 1971 p 87-95 refs (See N72-13391 04-15)
Avail: NTIS CSCL 13I

N72-13403*# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
LOW NUTATION-RATE DAMPERS
Barry E. Tossman *In* NASA. Goddard Space Flight Center 5th Aerospace Mech. Symp. 1971 p 97-102 refs (See N72-13391 04-15)
Avail: NTIS CSCL 13I

N72-13404*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
NUTATION DAMPERS FOR MANNED SPACECRAFT
Peter R. Kurzhals *In its* 5th Aerospace Mech. Symp. 1971 p 103-109 refs (See N72-13391 04-15)
Avail: NTIS CSCL 13I

N72-13405*# Ball Bros. Research Corp., Boulder, Colo.
A SCANNING MIRROR SYSTEM FOR THE APOLLO TELESCOPE MOUNT ULTRAVIOLET SPECTROHELIOMETER
Clifton O. Highman *In* NASA. Goddard Space Flight Center 5th Aerospace Mech. Symp. 1971 p 113-120 refs Prepared for Harvard Coll. Obs., Cambridge, Mass. (See N72-13391 04-15)
(Contracts NAS5-3949; HCO-Subcontract-B-9651)
Avail: NTIS

N72-13412*# Radio Corp. of America, Princeton, N.J. Astro-Electronics Div.
A LIGHTWEIGHT BIMETALLIC ACTUATOR FOR SPACECRAFT THERMAL CONTROL
Keith L. Schilling *In* NASA. Goddard Space Flight Center 5th Aerospace Mech. Symp. 1971 p 165-170 refs (See N72-13391 04-15)
Avail: NTIS CSCL 14B

N72-13958# Royal Swedish Academy of Engineering Sciences, Stockholm.
NEW MEASUREMENT AND CONTROL EQUIPMENT
In its Develop. in Res. and Technol. during 1970 1970 p 157-160 refs In SWEDISH (See N72-13942 04-34)
Avail: NTIS; Almqvist & Wiksell, Stockholm: 25 Kr

15 MACHINE ELEMENTS AND PROCESSES

Includes bearings, seals, pumps, and other mechanical equipment; lubrication, friction, and wear; manufacturing processes and quality control, and reliability; drafting; and materials fabrication, handling, and inspection.

N72-13386 National Lending Library for Science and Technology, Boston Spa (England).
THE LAWS OF DRAWING AND SPINNING FOR THE FORMING OF SHEET MATERIAL
W. Panknin [1971] 25 p refs Transl. into ENGLISH from Z. Metallk. (Stuttgart), v. 61, no. 6, Jun. 1970 p 407-414
(NLL-M-20899-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 2 NLL photocopy coupons

An introduction to the laws governing the processes of drawing and spinning is presented. Predominant emphasis is on the limits of deformation. Hollow bodies are discussed in particular. Author

N72-13387# Soviet Radio, Moscow (USSR).
TABLES FOR CALCULATING RELIABILITY AND OPTIMAL RESERVE
A. L. Raykin, O. S. Kravtsov, and V. S. Penin 1971 222 p refs In RUSSIAN
Avail: NTIS

Tables are presented for the logarithmic increase of accuracy in studies of reserve systems. They permit the manual solution of problems of optimal reserve systems composed of elements of various types (i.e., ones which differ in reliability, cost, weight, etc.) In addition, these tables, together with use of tables of natural logarithms, permit the determination of reserve system reliability, if reserve elements are included in emergency calculations in the case of failure of the working elements. The basic principles of reserve calculation are applied to the optimal distribution of organic resources. A rapid approximation algorithm for optimization is presented, and questions of regulation of excess reserves are considered within the framework of present knowledge of alternate methods of dynamic programming. Reliability function properties are noted which can be applied to the solution of optimization method problems in marginal analysis. Transl. by K.P.D.

N72-13388# Technische Hochschule Hannover (West Germany).
PROCEDURE AND ANALYZATION SYSTEM FOR STUDYING WELDING-ARC VOLTAGE FLUCTUATIONS DURING ELECTRIC WELDING PROCEDURES Ph.D. Thesis [VERFRHREN UND ANALYSIEREINRICHTUNG ZUR UNTERSUCHUNG DER SCHWEISSSPANNUNGS-SCHWANKUNGEN BEI ELEKTROSCHWEISSVERFAHREN]
Dietrich Rehfeldt 1969 176 p refs In GERMAN
Avail: NTIS

Electronic equipment and methods are described for the statistical determination of welding arc amplitude fluctuations during the working process. Characteristics of arc amplitude and welding voltage are used to describe time-fusion histories of Kb, Ti, and Es rod electrodes as well as of wire in carbon dioxide welding and to define the effects of enveloping current density, current type, and weld current strength. Transl. by G. G.

N72-13389*# Pyronetics, Inc., Santa Fe Springs, Calif.
EVALUATION TEST PROGRAM, VALVE, EXPLOSIVE ACTUATED, NORMALLY CLOSED PYRONETICS MODEL 1400
Edward Avalos 5 Oct. 1971 64 p refs
(JPL Order ES-536829)
(NASA-CR-124717; QC/R-6-046) Avail: NTIS CSCL 13K

Evaluation tests of the explosive actuated normally closed valves used to control and isolate hydrazine flow in the TOPS spacecraft, are presented. The malfunctions, modifications, service life, and reliability of the valve are also outlined. E.H.W.

N72-13390*# Transportation Systems Center, Cambridge, Mass.
METALLIZATION FAILURES
Rosemary Beatty May 1971 115 p refs
(NASA-Order R-1130)
(NASA-CR-124727; DOT-TSC-NASA-71-9) Avail: NTIS CSCL 13H

Metallization-related failure mechanisms were shown to be a major cause of integrated circuit failures under accelerated stress conditions, as well as in actual use under field operation. The integrated circuit industry is aware of the problem and is attempting to solve it in one of two ways: (1) better understanding of the aluminum system, which is the most widely used metallization material for silicon integrated circuits both as a single level and multilevel metallization, or (2) evaluating

alternative metal systems. Aluminum metallization offers many advantages, but also has limitations particularly at elevated temperatures and high current densities. As an alternative, multilayer systems of the general form, silicon device-metal-inorganic insulator-metal, are being considered to produce large scale integrated arrays. The merits and restrictions of metallization systems in current usage and systems under development are defined. Author

N72-13391*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
FIFTH AEROSPACE MECHANISMS SYMPOSIUM
Washington 1971 196 p refs Proceedings of conf. held in Greenbelt, Md., 15-16 Jun. 1970; sponsored by NASA. Goddard Space Flight Center, Santa Clara Univ., and Lockheed Missiles and Space Co.
(NASA-SP-282) Avail: NTIS CSCL 13I

Structural design principles and mechanical engineering methods in developing various types of aerospace mechanisms used in orbital and space flights are reported. Topics include descriptions of an electromechanical docking mechanism attenuator, of various nutation dampers, and of numerous mechanical spacecraft subsystems. For individual titles, see N72-13392 through N72-13415.

N72-13392*# North American Rockwell Corp., Downey, Calif.
THE APOLLO DOCKING SYSTEM **c31**
Kenneth A. Bloom and George E. Campbell *In* NASA. Goddard Space Flight Center 5th Aerospace Mech. Symp. 1971 p 3-8 (See N72-13391 04-15)
(Contract NAS9-150)
Avail: NTIS CSCL 22B

The Apollo docking system is the means by which the Apollo command and service modules and the lunar module are connected and disconnected during a lunar-landing mission. The system incorporates a CSM probe assembly that mates with a drogue assembly on the LM. Twelve automatic latches mounted on the CSM docking ring provide for structural integrity between the vehicles and for tunnel sealing during crew transfer. A functional description of the flight hardware and the alternate concepts that were evaluated to determine the system best suited to Apollo requirements are presented. Author

N72-13393*# Naval Weapons Center, China Lake, Calif.
DYNAMIC BEHAVIOR OF THE MERCURY DAMPER **c14**
Prescott D. Crout (MIT) and Horace L. Newkirk *In* NASA. Goddard Space Flight Center 5th Aerospace Mech. Symp. 1971 p 9-16 refs This paper is based on reports NAVWEPS-8611 and NOTS-TP-3635 (See N72-13391 04-15)
Avail: NTIS CSCL 14B

The dynamic behavior of the mercury nutation damper is investigated. Particular attention is paid to the eccentric annular mercury configuration, which is the final continuous ring phase that occurs in the operation of all mercury dampers. In this phase, damping is poorest, and the system is closely linear. During the investigation, the hydrodynamic problem is treated as three dimensional, and extensive use is made of a variational principle of least-viscous frictional power loss. A variational principle of least-constraint is also used to advantage. Formulas for calculating the behavior of the mercury damper are obtained. Some confirmatory experiments were performed with transparent ring channels on a laboratory gyroscope. Selected movie frames taken during wobble damping are shown along with the results of film measurements. Author

N72-13394*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
AEROSPACE VEHICLE SEPARATION MECHANISMS SELECTION, DESIGN, AND USE CONSIDERATIONS **c31**
I. B. Gluckman *In* NASA. Goddard Space Flight Center 5th Aerospace Mech. Symp. 1971 p 17-23 refs (See N72-13391 04-15)
Avail: NTIS CSCL 22B

The principal types of separation systems and mechanisms used in spacecraft are described and compared. Important parameters to be considered in tradeoff studies are discussed. Several examples of successful applications and failures and the lessons learned from them are discussed. Author

N72-13395*# Boeing Co., Seattle, Wash. Aerospace Systems Div.
ROTARY RELAY FOR SPACE POWER TRANSFER **c09**
H. Theron Haynie *In* NASA. Goddard Space Flight Center 5th Aerospace Mech. Symp. 1971 p 25-31 (See N72-13391 04-15)
Avail: NTIS CSCL 09E

The power clutch presented is designed for the transfer of electrical signals and power across rotating joints. Radio noise, friction, and wear are virtually eliminated. The design, construction, and applications are discussed. This clutch eliminates the need of recycling solar arrays once each orbit by recycling only a low-inertia component of the power system. Author

N72-13396*# Maryland Univ., College Park. Dept. of Mechanical Engineering.
RESPONSE CHARACTERISTICS OF A THERMAL-HELIOTROPE SOLAR-ARRAY ORIENTATION DEVICE **c14**
Frederick H. Morse *In* NASA. Goddard Space Flight Center 5th Aerospace Mech. Symp. 1971 p 33-39 refs (See N72-13391 04-15)
Avail: NTIS CSCL 14B

The thermal heliotrope is a passive solar-array orientation device containing a bimetallic helix that rotates when activated by solar energy. The rate and extent of the rotation depends upon the properties of the two metals and the temperature of the helix. An energy-balance analysis is performed to determine the temperature distribution in the helix. By initially restricting the analysis, a simplified equation governing the response of the heliotrope is obtained. In order to gain insight into the response of the heliotrope, a series of experiments were performed. The results of these tests and the implications are presented. Author

N72-13397*# Academy of Sciences (USSR), Moscow. Inst. for Machine Technology.
DOCKING-MECHANISM ATTENUATOR WITH ELECTRO-MECHANICAL DAMPER **c31**
Vladimir S. Syromyatnikov *In* NASA. Goddard Space Flight Center 5th Aerospace Mech. Symp. 1971 p 43-57 (See N72-13391 04-15)
Avail: NTIS CSCL 22B

Theoretical and practical problems involved in the application of electromechanical damping for spacecraft docking-mechanism attenuation are discussed. Some drawbacks of hydraulic dampers used for the purpose are pointed out. The basic scheme of the attenuator with the electromechanical damper is given. Author

N72-13398*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
DAMPER DESIGN FROM A STRUCTURAL ENGINEER'S POINT OF VIEW **c14**
Jay C. Chen *In* NASA. Goddard Space Flight Center 5th Aerospace Mech. Symp. 1971 p 59-64 ref (See N72-13391 04-15)
Avail: NTIS CSCL 13I

A nonlinear structural analysis, employing the nonlinear damper characteristics obtained from a damper test, was successfully performed on the Mariner spacecraft's solar-panel system, and the result was compared with results from a system-level spacecraft test in which some solar-panel tip dampers bottomed at a certain frequency. The analysis showed that the damper bottoming was attributable to a jump phenomenon that can result when a damper's response is not single-valued at some frequency. Author

N72-13399*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THERMOMECHANICAL PISTON PUMP DEVELOPMENT
Eric E. Sabelman *In* NASA. Goddard Space Flight Center 5th Aerospace Mech. Symp. 1971 p 65-70 refs (See N72-13391 04-15)
(Contract NAS7-100)
Avail: NTIS CSCL 13K

A thermally powered reciprocating pump has been devised to replace or augment an electric pump for the transport of temperature-control fluid on the Thermoelectric Outer Planet Spacecraft (TOPS). The thermally powered pump operates cyclically by extracting heat energy from the fluid by means of a vapor-pressure expansion system and by using the heat to perform the mechanical work of pumping. A feasibility test unit has been constructed to provide an output of 7 cu in during a 10- to 100-second cycle. It operates with a fluid input temperature of 200 to 300 F and a heat sink temperature of 0 to 30 F. Author

N72-13400*# Lockheed Missiles and Space Co., Palo Alto, Calif.
INTRODUCTION TO PASSIVE NUTATION DAMPERS c14
George C. Herzl *In* NASA. Goddard Space Flight Center 5th Aerospace Mech. Symp. 1971 p 73-81 refs (See N72-13391 04-15)
Avail: NTIS CSCL 13I

Coning motion can prevent photographic and TV cameras and other oriented spacecraft experiments from maintaining a steady scan, and it can introduce a ripple in the high-gain communication system. Nutation dampers are used to remove this type of spacecraft instability. The first nutation damper flown in a missile for the stabilization of the gyroscope consisted of a hollbw ring that was partially filled with mercury, and the sloshing of the mercury dissipated the nutational energy. A similar mercury-ring damper was used in the Pioneer 1 lunar probe in 1958 and became the first nutation damper to be used in space. Since then many types of nutation dampers have been designed for spin-stabilized spacecraft ranging in size from small scientific satellites to large space stations. Author

N72-13401*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
NUTATION DAMPERS FOR SINGLE-SPIN SATELLITES
Joseph V. Fedor *In its* 5th Aerospace Mech. Symp. 1971 p 83-85 (See N72-13391 04-15)
Avail: NTIS CSCL 13I

The physical principles, analysis, and some of the design considerations of passive nutation dampers for single-spin satellites are discussed. Author

N72-13402*# Ball Bros. Research Corp., Boulder, Colo.
NUTATION-DAMPER DESIGN FOR DUAL-SPIN SPACECRAFT c14
Thomas M. Spencer *In* NASA. Goddard Space Flight Center 5th Aerospace Mech. Symp. 1971 p 87-95 refs (See N72-13391 04-15)
Avail: NTIS CSCL 13I

A dual-spin spacecraft is a spin-stabilized spacecraft consisting of two major structures. Momentum is stored in the spinning wheel, while the sail, or platform, can be despun at various rates about the spacecraft axis. Factors that affect the design of nutation-control systems for single- and dual-spin spacecraft are discussed. The nutation-control system of the Orbiting Solar Observatory spacecraft is described. Author

N72-13403*# Applied Physics Lab., Johns Hopkins Univ., Silver Spring, Md.
LOW NUTATION-RATE DAMPERS c14
Barry E. Tossman *In* NASA. Goddard Space Flight Center 5th Aerospace Mech. Symp. 1971 p 97-102 refs (See N72-13391 04-15)
Avail: NTIS CSCL 13I

Mission requirements plus spacecraft weight and power constraints often reduce the excitation frequency of a nutation damper below 1 cpm. Since attitude stability is determined by damper performance, maximum effectiveness at low rates is demanded. Presented are design considerations that low-frequency dampers require, along with descriptions of two low-frequency systems: the Direct Measurement Explorer 1 and the Small Astronomy Satellite A (SAS-A). Author

N72-13404*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
NUTATION DAMPERS FOR MANNED SPACECRAFT c14
Peter R. Kurzhals *In its* 5th Aerospace Mech. Symp. 1971 p 103-109 refs (See N72-13391 04-15)
Avail: NTIS CSCL 13I

Nutation dampers are examined from the standpoint of application to manned space stations with artificial gravity. Typical spacecraft concepts and associated control requirements are considered, and examples of the dampers proposed for these spacecraft are discussed. Author

N72-13405*# Ball Bros. Research Corp., Boulder, Colo.
A SCANNING MIRROR SYSTEM FOR THE APOLLO TELESCOPE MOUNT ULTRAVIOLET SPECTROHELIOMETER c14
Clifton O. Highman *In* NASA. Goddard Space Flight Center 5th Aerospace Mech. Symp. 1971 p 113-120 refs Prepared for Harvard Coll. Obs., Cambridge, Mass. (See N72-13391 04-15)
(Contracts NAS5-3949; HCO-Subcontract-B-9651)
Avail: NTIS

The scanning mirror system described is being developed as the primary mirror in the spectroheliometer. The system consists of a gimbaled mirror mount that is rotated through extremely small angles by the use of frictionless pivots and a closed-loop servo system. Design, fabrication, and test experience are discussed. Author

N72-13406*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
A RELEASE MECHANISM WITH MECHANICAL REDUNDANCY
John J. Paradise *In* NASA. Goddard Space Flight Center 5th Aerospace Mech. Symp. 1971 p 121-126 Sponsored by NASA. Lewis Res. Center (See N72-13391 04-15)
Avail: NTIS CSCL 13E

A simple release mechanism is described that achieves high reliability through active mechanical redundancy on the SERT 2 satellite. Principle of operation, design details, and the test program are discussed. Examples of developmental and proposed alternate configurations also are included. Author

N72-13407*# Hughes Aircraft Co., El Segundo, Calif. Space Systems Div.
ACCELERATED VACUUM TESTING OF LONG LIFE BALL BEARINGS AND SLIPRINGS
C. R. Meeks, R. I. Christy, and A. C. Cunningham *In* NASA. Goddard Space Flight Center 5th Aerospace Mech. Symp. 1971 p 127-135 ref (See N72-13391 04-15)
Avail: NTIS CSCL 13I

Extensive analytical studies and testing have been conducted on bearings and sliprings in vacuum at temperatures from 30 to 130 F. Thirty-six bearings lubricated with two types of oil were tested in vacuum of less than 10 to the minus 8th power torr at speeds from 55 to 180 rpm. Temperatures, load, speed, and oil viscosity were varied to evaluate the effects on life and wear. All bearings performed successfully during a 7-month test, and the potential merits of the two oils were compared. Over 25 different, dry-lubricated brush/slipring material combinations have been tested, with variations of brush and ring design and surface speed. Test results indicate the probability of

10 years or more of slipring and brush lifetime with properly designed brushes for 1-in.-diameter ring rotating at 60 rpm.
Author

N72-13408*# Spar Aerospace Products, Ltd., Malton (Ontario).
A MOTOR CANISTER DESIGNED FOR PROLONGED OPERATION IN SPACE
Alan Wells *In* NASA. Goddard Space Flight Center 5th Aerospace Mech. Symp. 1971 p 137-142 (See N72-13391 04-15)
Avail: NTIS CSCL 13I

A special canister was designed to protest the dc motors used on the ISIS 1 antenna unit. The canister is provided with a pressure-monitoring device and has a special shaft seal that imparts minimum load to the motor output shaft. The development and flight testing of the canister are discussed. Problems that were encountered during fabrication and inspection and the problems caused by material/lubricant incompatibility and low temperature are also discussed. Author

N72-13409*# TRW Systems Group, Redondo Beach, Calif.
EFFECTS OF ENERGY DISSIPATION IN THE BEARING ASSEMBLIES OF DUAL-SPIN SPACECRAFT
Mark P. Scher *In* NASA. Goddard Space Flight Center 5th Aerospace Mech. Symp. 1971 p 143-148 refs (See N72-13391 04-15)
Avail: NTIS CSCL 13I

Proper evaluation of the effects of bearing assembly flexibility on the attitude stability of dual-spin spacecraft may explain the observed anomalies in the motion of a recently launched satellite. A convenient, but approximate, expression with which to gauge these effects is presented, as in an example of a possible application of this expression in a design role.
Author

N72-13410*# Du Pont de Nemours (E. I.) and Co., Wilmington, Del.
METAL-SILICATE FRICTION IN ULTRAHIGH VACUUM
E. I. Ofodile and Joseph Frisch (Calif. Univ., Berkeley) *In* NASA. Goddard Space Flight Center 5th Aerospace Mech. Symp. 1971 p 149-156 refs (See N72-13391 04-15)
Avail: NTIS CSCL 20K

Results of the analysis and experiments on the frictional behavior of materials under conditions of ultrahigh vacuum, as related to kinematic problems in a lunar environment, are presented. Experiments have been performed under varying conditions of cleanliness to determine frictional characteristics at 10 to the minus 7th power to 10 to the minus 8th power torr between flat basalt and spherical 7075-T6 aluminum surfaces. A quantitative analysis has been made of the factors influencing frictional behavior of these materials. The proposed mathematical model incorporated parameters of surface cleanliness, surface roughness, and surface energy. Author

N72-13411*# National Aeronautics and Space Administration. Goddard Space Flight Center, Greenbelt, Md.
MEETING THE CHALLENGE OF A 50000-HOUR-LIFE-TIME REQUIREMENT
Charles E. Vest and Philip A. Studer *In its* 5th Aerospace Mech. Symp. 1971 p 159-164 refs (See N72-13391 04-15)
Avail: NTIS CSCL 14D

Space mission requirements for the 70's have established a 50,000-hour-lifetime challenge for the mechanisms designer. This challenge may be met by two approaches: (1) development of new materials for wear-prone elements, and (2) design innovation of new electromechanical devices that do not include mechanical wear-prone components. Present state-of-the-art materials require restricted operation regarding load, speed, and power for gears, bearings, and brush-slipring components. These restrictions are discussed, and methods of improvement are suggested. The design-innovations approach is discussed and is illustrated by the design of an experimental magnetically suspended motor. Author

N72-13412*# Radio Corp. of America, Princeton, N.J. Astro-Electronics Div.
A LIGHTWEIGHT BIMETALLIC ACTUATOR FOR SPACECRAFT THERMAL CONTROL c14
Keith L. Schilling *In* NASA. Goddard Space Flight Center 5th Aerospace Mech. Symp. 1971 p 165-170 refs (See N72-13391 04-15)
Avail: NTIS CSCL 14B

The design, development, and construction of two types of active thermal-control systems are described. These designs are based on the controlled angular deflections of spiral-wound bimetallic actuators. The use of these actuators and lightweight louvers results in a frictionless system that is low in weight yet simple in design and low in cost. Both designs exhibit high reliability, good performance repeatability, and do not require power from the spacecraft. Design philosophy and implementation, design tradeoffs, and materials selection are reviewed. The test program is described, and results are presented. Author

N72-13413*# Little (Arthur D.), Inc., Cambridge, Mass.
THE APOLLO 11 LASER RANGING RETRO-REFLECTOR ARRAY c16
John E. McCullough *In* NASA. Goddard Space Flight Center 5th Aerospace Mech. Symp. 1971 p 171-175 Supported by NASA (See N72-13391 04-15)
Avail: NTIS CSCL 20E

The laser ranging retro-reflector now deployed at Tranquility Base consists of an array assembly housing 100 fused-silica retro-reflectors mounted on a pallet-aiming assembly resting on the lunar surface. The array assembly serves to hold, optically align, and thermally isolate the retro-reflectors to preserve optimum optical performance at all operating temperatures in the expected range from -300 to 250 F. Author

N72-13414*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
DEVELOPMENT OF PAYLOAD SUBSYSTEM-PRIMATE MISSION-BIOSATELLITE PROGRAM c31
James F. Hall, Jr. *In* NASA. Goddard Space Flight Center 5th Aerospace Mech. Symp. 1971 p 177-183 This paper is based on NASA-CR-73424 prepared for Ames Res. Center under contract NAS2-1900 (See N72-13391 04-15)
Avail: NTIS CSCL 22B

Design and operation of the primate life support subsystem for the Biosatellite Program as used during the flight of Biosatellite 3 are discussed. Included are preflight changes necessiated by the primate's (a Macaca nemistrina monkey) influence on the initial equipment design. Author

N72-13415*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THE MARINER MARS 1971 GIMBAL ACTUATOR c21
Gerald S. Perkins *In* NASA. Goddard Space Flight Center 5th Aerospace Mech. Symp. 1971 p 185-191 ref (See N72-13391 04-15)
(Contract NAS7-100)
Avail: NTIS CSCL 17G

The actuator that will point the gimbaled engine, thus performing the autopilot actuation function for the Mariner Mars 1971 spacecraft, is described. The gimbaled engine has two axes of freedom, providing two-axis control to the spacecraft. Motion for the two axes is provided by identical and interchangeable actuators-gearless electromechanical linear servomechanisms. Each actuator is designed to have a long service life in the space environment and to be able to function at speeds ranging from hours per cycle to cycles per second.
Author

N72-13416*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
SATURN COMPONENT FAILURE RATE AND FAILURE

RATE MODIFIERS
[1971] 63 p
(NASA-TM-X-64619) Avail: NTIS CSCL 14D

Failure mode frequency ratios, environmental adjustment factors, and failure rates for mechanical and electromechanical component families are presented. The failure rates and failure rate modifiers resulted from a series of studies whose purpose was to provide design, tests, reliability, and systems engineers with accurate, up-to-date failure rate information. The results of the studies were achieved through an extensive engineering analysis of the Saturn Program test data and Unsatisfactory Condition Reports (UCR's) and the application of mathematical techniques developed for the studies. Author

N72-13417*# ABT Associates, Inc., Cambridge, Mass.
APPLICATIONS OF AEROSPACE TECHNOLOGY IN INDUSTRY. A TECHNOLOGY TRANSFER PROFILE: WELDING
Donald M. Murray Sep. 1971 60 p refs
(Contract NASw-2022)
(NASA-CR-124816) Avail: NTIS CSCL 13H

Welding technology is reviewed along with NASA's contributions to the technology. Specific examples of welding technology transfer are given. F.O.S.

N72-13418*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PREDICTED CHARACTERISTICS OF AN OPTIMIZED SERIES-HYBRID CONICAL HYDROSTATIC BALL BEARING
Lester J. Nypan, Bernard J. Hamrock, Herbert W. Scibbe, and William J. Anderson Washington Dec. 1971 28 p refs
(NASA-TN-D-6607; E-6507) Avail: NTIS CSCL 13I

Optimized series-hybrid fluid-film ball bearings are described and operating characteristics are calculated and discussed. It is predicted that a series-hybrid bearing may be constructed which will reduce ball-bearing speed by 30 percent thereby increasing bearing fatigue life by factors of up to 5.9. Flow rates required are less than 9 kilograms per minute. Author

N72-13419*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
BIBLIOGRAPHY OF ARTICLES AND REPORTS ON MINERAL-SEPARATION TECHNIQUES, PROCESSES, AND APPLICATIONS
Russell S. Harmon, (comp.) Dec. 1971 15 p refs
(NASA-TM-X-58073) Avail: NTIS CSCL 13H

A bibliography of published articles and reports on mineral-separation techniques, processes, and applications is presented along with an author and subject index. This information is intended for use in the mineral-separation facility of the Lunar Receiving Laboratory at the NASA Manned Spacecraft Center and as an aid and reference to persons involved or interested in mineral separation. Author

N72-13420*# National Aeronautics and Space Administration, Washington, D.C.
PIPING AND TUBING TECHNOLOGY: A COMPILATION Technology Utilization
1971 24 p
(NASA-SP-5903(02)) Avail: NTIS

A compilation on the devices, techniques, and methods used in piping and tubing technology is presented. Data cover the following: (1) a number of fittings, couplings, and connectors that are useful in joining tubing and piping and various systems, (2) a family of devices used where flexibility and/or vibration damping are necessary, (3) a number of devices found useful in the regulation and control of fluid flow, and (4) shop hints to aid in maintenance and repair procedures such as cleaning, flaring, and swaging of tubes. E.H.W.

N72-13421*# Aerojet Liquid Rocket Co., Sacramento, Calif.
AN EVALUATION OF A HUBLESS INDUCER AND A FULL FLOW HYDRAULIC TURBINE DRIVEN INDUCER BOOST PUMP
B. K. Lindley and A. R. Martinson Nov. 1971 136 p refs
(Contract NAS3-11218)
(NASA-CR-72995; Rept-11218-F) Avail: NTIS CSCL 13K

The purpose of the study was to compare the performance of several configurations of hubless inducers with a hydrodynamically similar conventional inducer and to demonstrate the performance of a full flow hydraulic turbine driven inducer boost pump using these inducers. A boost pump of this type consists of an inducer connected to a hydraulic turbine with a high speed rotor located in between. All the flow passes through the inducer, rotor, and hydraulic turbine, then into the main pump. The rotor, which is attached to the main pump shaft, provides the input power to drive the hydraulic turbine which, in turn, drives the inducer. The inducer, rotating at a lower speed, develops the necessary head to prevent rotor cavitation. The rotor speed is consistent with present main engine liquid hydrogen pump designs and the overall boost pump head rise is sufficient to provide adequate main pump suction head. This system would have the potential for operating at lower liquid hydrogen tank pressures. Author

N72-13422*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
RELIABILITY COMPUTATION USING FAULT TREE ANALYSIS
Paul O. Chelson 1 Dec. 1971 23 p refs
(Contract NAS7-100)
(NASA-CR-124740; JPL-TR-32-1542) Avail: NTIS CSCL 14D

A method is presented for calculating event probabilities from an arbitrary fault tree. The method includes an analytical derivation of the system equation and is not a simulation program. The method can handle systems that incorporate standby redundancy and it uses conditional probabilities for computing fault trees where the same basic failure appears in more than one fault path. Author

N72-13423# Bureau of Mines, Reno, Nev.
ELECTROWINNING OF OXYGEN FROM SILICATE ROCKS
D. G. Kesterke 1971 15 p refs
(BM-RI-7587; TN23.U7-NO-7587; Dewey-7587; LC-622.06173) Avail: NTIS

Research was conducted to determine the feasibility of extracting elemental oxygen from silicate-bearing melts by high temperature electrolysis. The method was based on a modification of existing processes for electrowinning metals from their oxides dissolved in molten halide systems. Electrolysis was performed at temperatures ranging from 1,050 to 1,250 C in boron nitride cells that incorporated a silicon carbide cathode and an iridium anode. The electrolytes contained volcanic scoria as the oxygen source, plus mixtures of BaF2 and LiF as fluxing agents. Cell gases containing almost 14 volume-percent oxygen were obtained. The average anode current efficiency for several experiments of extended duration was calculated to be 55 percent. Cell design and operating conditions are described, and some of the problems associated with the process are discussed. Author

N72-13424# Politecnico di Torino (Italy). Ist. di Macchine e Motori per Aeromobili.
DESIGN OF A SIMULATED INERTIAL DYNAMOMETRIC BRAKE [PROVA DI UN FRENO DINAMOMETRICO AD INERZIA SIMULATA]
M. Adriano, A. Dadone, and G. Follis Jan. 1970 22 p refs In ITALIAN Sponsored by Centro Studi Macchine Movimento Terra e Veicoli Fuori strada
(Publ-118) Avail: NTIS

Solutions to the problems involved in developing an inertial acceleration brake are presented. These data are also used to test motors at constant velocity and constant load along the utilization curve. Results from tests of the brake in the transient

(acceleration) and stationary mode are given with and without motion resistance. ESRO

N72-13425# Louvain Univ. (Belgium). Inst. of Mechanical Manufacturing.

THE MEASUREMENT OF THE DYNAMIC CUTTING COEFFICIENT

Jacques Peters (Centre de Rech. Sci. et Tech. de l'Ind. des Fabric. Metal.), Paul Vanherck (Centre de Rech. Sci. et Tech. de l'Ind. des Fabric. Metal.), and Hendrik VanBrussel (Centre de Rech. Sci. et Tech. de l'Ind. des Fabric. Metal.) Brussels Centre de Rech. Sci. et Tech. de l'Ind. des Fabric. Metal. Jun. 1971 40 p refs Presented at the Gen. Assembly of the Coll. Intern. pour la Rech. sur la Production Mecan., Warsaw, Sep. 1971

(CRIF-MC-39) Avail: NTIS

The measurement of the dynamic cutting coefficient of numerically controlled machine tools is discussed and current methods for measuring the cutting stiffness reviewed. A new technique using a test rig rather than a dynamometer is described which overcomes previous difficulties and allows stability predictions. ESRO

N72-13426# National Physical Lab., Teddington (England). Div. of Inorganic and Metallic Structure.

FINE POWDERS: PREPARATION, PROPERTIES, AND USES: A REVIEW

C. R. Veale Aug. 1971 108 p refs

(NPL-IMS-13) Avail: NTIS

Methods of preparation and characterization of fine powders are considered. Chemical and physical properties of the surface are detailed. Use of fine powder in reinforcements in surface coatings and in sintering and hotpressing processes is emphasized. Other fine powder properties such as agglomeration, flow properties, thermal conductivity, etc., are reviewed. ESRO

N72-13427# Army Foreign Science and Technology Center, Charlottesville, Va.

THERMODYNAMIC ANALYSIS OF CIRCULATION METHOD IN COATING FORMATION

B. N. Arzamasov 30 Jun. 1971 11 p refs Transl. into ENGLISH from Zashchitn. Pokrytiya na Metallakh (USSR), 1968 p 68-72

(AD-728592; FSTC-HT-23-980-71) Avail: NTIS CSCL 13/8

The circulation method for the generation of a coating over metal is described. The proposed reaction sequence is supported by thermodynamic considerations. Author (GRA)

N72-13428# Utah Univ., Salt Lake City. Div. of Materials Science and Engineering.

CHEMICAL VAPOR DEPOSITION Semiannual Progress Report

May 1971 23 p refs

(Contract DAHC15-69-C-0127; ARPA Order-1285)

(AD-725833; UTEC-MSE-71-084) Avail: NTIS CSCL 13/8

The report discusses the chemical vapor deposition of tungsten on a copper substrate using tungsten hexafluoride and hydrogen. The crystal properties of the tungsten are mentioned. Microhardness measurements on material depositied at each of 500 and 700C are reported. The morphologies of the fracture faces for all tests were observed with scanning electron microscopy although no pictures are presented in the report. Square holes have been observed in transmission electron microscopic observations of sections parallel to the growing interface. For W-22% Rh alloy it is now thought that observed grain growth rate decreases at longer annealing times are caused by the development of bubbles on the grain boundaries. GRA

N72-13429# Vought Aeronautics, Dallas, Tex.

DEVELOPMENT OF FASTENER COUNTERSINK CORROSION PROTECTION SEALS Final Report, 24 Jan. 1970 - 24 Apr. 1971

G. W. Kelly Apr. 1971 72 p refs

(Contract N00019-70-C-0244)

(AD-728039; VAC-2-53110/IR-2916) Avail: NTIS CSCL 11/1

The objects of the program were to modify coating materials for use with specialized application equipment, to study application techniques applicable to production practices and to develop a color stable (non-yellowing) material suitable for this use. All objectives were oriented toward development of an elastomeric sealant system designed for use in sealing fastener-head countersinks in highly loaded aircraft skins that are susceptible to exfoliation corrosion. Materials were formulated that could be smoothly deposited on vertical surfaces to thicknesses of 5 to 7 mils per pass utilizing vapor-carrier type spray equipment; other materials formulated for use in conventional application equipment were easily applied to an aesthetically smooth finish with a minimum loss of coating build per pass. These coatings were manufactured in commercial facilites and test results obtained from these materials correlated with laboratory experimental data. Materials and application techniques developed as a result of this program have significantly reduced the costs of applying fastener-countersink seals to production aircraft. Author (GRA)

N72-13430# Naval Construction Research Establishment, Dunfermline (Scotland).

PRELIMINARY TESTS IN THE USES OF STRESS WAVE EMISSION ANALYSIS FOR THE DETECTION OF CRACKING DURING WELDING

W. H. Winn, F. B. Sawyer, and C. M. Richards Feb. 1971 16 p refs

(AD-730391; NCRE/R568; NSTIC-29198/5) Avail: NTIS CSCL 13/5

Stress wave emission analysis techniques was used to detect cracking which occurs immediately after welding in CTS tests, butt-weld cracking tests and in the root pass of full-size butt welds. There is a correlation between the length of crack and the total area of the bursts of energy as recorded on an ultra-violet trace. Author

N72-13431# Lockheed-Georgia Co., Marietta. Advanced Structures Div.

DEVELOPMENT OF AN UNDERSTANDING OF THE FATIGUE PHENOMENA OF BONDED AND BOLTED JOINTS IN ADVANCED FILAMENTARY COMPOSITE MATERIALS Interim Report, Mar. 1970 - Feb. 1971

Albert C. Fehrle, J. N. Jackson, G. W. Fambro, J. M. McKinney, A. R. Holland, E. C. Young, R. E. Shupe, G. J. Gilbert, and S. M. Freeman Wright-Patterson AFB, Ohio AFFDL Jun. 1971 259 p refs

(Contract F33615-70-C-1302; AF Proj. 4364)

(AD-729189; AFFDL-TR-71-44; Rept-03; Rept-04) Avail: NTIS CSCL 13/5

Program efforts were directed primarily to planning, joint design, joint analysis and basic evaluation of boron-epoxy material. The planning efforts resulted in the establishment of the type of specimens, specimen identification, test parameters, and number of specimens required for accomplishing the objectives of this program. A closed form joint analysis has been developed for the elastic condition. This solution has also been expanded to include nonlinear adhesive properties for ultimate joint strength and analysis. Correlation between constant amplitude-frequency fatigue testing and spectrum loading has been initiated. Failure mode studies have been conducted for specimens subjected to various types of loading and definite failure modes have been established for specific loading conditions. Author (GRA)

N72-13432# Pratt and Whitney Aircraft, West Palm Beach, Fla. Research and Development Center.

BEARING AND SEAL TECHNOLOGY REVIEW Final Report

Arthur F. Hiegel Jun. 1971 128 p

(Contract DAAJ02-68-C-0001)

(AD-729328; PWA-FR-4189; USAAMRDL-TR-71-26; Task-1G163201D44701) Avail: NTIS CSCL 13/9

Large and small engine main shaft bearings and seals were reviewed: (1) to identify large gas turbine engine bearing and seal concepts or characteristics which are applicable to small gas turbine engines of the 2-10 lb/sec airflow size, (2) to define large engine bearing and seal design standards for applicability to small gas turbine engines, (3) to determine suitable factors for scaling bearing and seal technology concepts from large gas turbine engines to small, 2 to 10 lb/sec airflow size turbine engines, (4) to recommend test programs to provide scaling data where scale factors are questionable, and (5) to determine what bearing and seal technology is lacking for advanced small engines. To accomplish this task, bearing and seal characteristics that might define standard design practices or scale factors were selected. After collection and compilation of pertinent data, comparisons were made to establish relationships between engine size and selected bearing and seal characteristics. In addition, comparisons of selected characteristics of large, mostly twin-spool engines versus small engine bearing, seal, and rotor dynamic characteristics were made. Author (GRA)

N72-13433# General Electric Co., West Lynn, Mass. Aircraft Engine Group.

BEARING AND SEAL SCALABILITY STUDY Final Report

Louis I. Zirin Jun. 1971 62 p refs

(Contract DAAJ02-68-C-0002; DA Proj. 1G1-163201-D-447)

(AD-729329; USAAMRDL-TR-71-27; Task-1G163201-D-44701) Avail: NTIS CSCL 11/1

During this analytical study, large aircraft gas turbine engine advanced bearing and seal technology was reviewed to determine those concepts which may be applicable to small, advanced, front drive turboshaft engines in the 2- to 10-lb/sec airflow size. Based on this review and a study of simple mechanical arrangements which appear to be feasible, problems associated with the design of the bearings and seals in these small, advanced turboshaft engines are discussed. Finally, design approaches and test programs required to provide solutions to these problems are recommended. Author (GRA)

N72-13434# Illinois Univ., Chicago. Dept. of Materials Engineering.

PRINCIPLES OF INCREMENTAL FORGING, PHASE 2 Final Report

P. H. Abramowitz and J. A. Schey Jul. 1971 75 p refs

(Contract N00019-70-C-0077)

(AD-729012; Rept-71-7) Avail: NTIS CSCL 13/8

The first phase of this program, established the feasibility of forging thin web-tall rib configurations typical of many airframe components by an incremental technique. In the second phase of the program, described in the report, the process was further developed by assuring accurate movement of the simultaneously indenting vertical and side anvils, and by feeding the workpiece with a manipulator developed for this task. The effects of process variables such as anvil length, bite, penetration and friction were investigated and the influence of process geometry on material displacement in a single indentation was explored in detail. In its present state of development, the process is capable of producing a thin web tall rib configuration with any number of stiffening cross ribs; rib and web thicknesses of 1/8 in. were achieved on the aluminum used as the simulating material.

Author (GRA)

N72-13435# Kaman Aerospace Corp., Bloomfield, Conn.

A FULL-SCALE EXPERIMENTAL FEASIBILITY STUDY OF HELICOPTER ROTOR ISOLATION USING THE DYNAMIC ANTIRESONANT VIBRATION ISOLATOR Final Report

Robert Jones Jun. 1971 137 p refs

(Contract DAAJ02-68-C-0094)

(AD-729317; R-892; USAAVLABS-TR-71-17; Task-1F162204A14608) Avail: NTIS CSCL 13/9

The report contains the results of a full-scale experimental feasibility study of rotor isolation employing the Dynamic Antiresonant Vibration Isolator (DAVI). The full-scale experiments were performed on a UH-2 helicopter fuselage isolated from a simulated rotor and transmission. Tests were conducted for three directions of vibratory input at the hub on the nonisolated vehicle and then compared to results obtained for the isolated vehicles. Tests on the isolated helicopter were conducted for two-bladed, three-bladed, and four-bladed rotor configurations. These rotor configurations were simulated by proper tuning of the DAVI isolation system to the predominant excitation frequency of the rotor systems. Results of this experimental study on a 6500-pound helicopter show that rotor isolation is feasible. Excellent reduction of vibration throughout the fuselage was obtained at the predominant excitation frequency (n-per-rev). This was accomplished with low static deflection, minimum weight penalty, and small relative vibratory deflections between the rotor and fuselage. Author (GRA)

N72-13436# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

HIGH TEMPERATURE NITRIDING OF CALORIZED STEEL

A. F. Sofroshenkov and L. G. Timonina 30 Jun. 1971 10 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Chernaya Met. (Moscow), v. 13, no. 7, 1970 p 138-140

(AF Proj. 7343)

(AD-729025; FTD-HT-23-328-71) Avail: NTIS CSCL 13/8

To reduce the time required for the nitriding of calorized steel, the temperature of nitriding was increased without decreasing the hardness of the calorized layer. Specimens from steel St. 3 were conventionally calorized in powders at 950 degrees for 4 to 6 hr., obtaining a calorized layer of 0.45-0.55 mm with a hardness of 350 to 380 kgf/sq mm and an Al concentration on the surface of 28 to 30%. To prevent the formation of a brittle layer during nitriding, 0.15 to 0.17 mm of the surface was polished away. The nitriding was carried out at 600, 700, 800, and 850 degrees with holding times 1, 2, 4, and 6 hr. Author (GRA)

16 MASERS

Includes applications of masers and lasers. For basic research see: 26 Physics, Solid State.

N72-13437* Sylvania Electronic Systems-Central, Williamsville, N.Y.

ACQUISITION AND TRACKING SYSTEM FOR OPTICAL RADAR patent

Charles L. Wyman, John M. Gould, Robert E. Johnson, and Paul F. Weiss, inventors (to NASA) 7 Sep. 1971 8 p Filed 4 Jun. 1969 Sponsored by NASA

(NASA-Case-MFS-20125; US-Patent-3,603,686; US-Patent-Appl-SN-830366; US-Patent-Class-356-152; US-Patent-Class-250-203X; US-Patent-Class-178-6; US-Patent-Class-178-DIG.21) Avail: US Patent Office CSCL 20E

A laser-based tracking system is described having the capability of automatically performing an acquisition search to locate a target. In the acquisition mode, a laser beam and the field of view of an image dissector photomultiplier are electronically and coaxially scanned over the same acquisition field. Upon acquisition of the target, the image dissectors field of view is scanned across the target in a cross-scan pattern. The error signal is fed back to center the laser beam and the cross-scan pattern on the target. When the target is lost, the system returns to the acquisition mode to scan both the laser beam and field of view of the image dissector over the acquisition field of view.

Official Gazette of the U.S. Patent Office

N72-13438*# Michigan Univ., Ann Arbor. High Altitude Engineering Lab.

OPERATION MANUAL FOR THE CO2 LASER SYSTEM

Final Report
Anders Daniels Aug. 1971 30 p refs
(Grant NGR-23-005-452; ORA Proj. 004780)
(NASA-CR-111992; Rept-004780-1-F) Avail: NTIS CSCL 20E

A detailed complete step by step procedure for the alignment and successful operation of the 10.6 m CO2 laser system used for the study of Mandelshtam-Brillouin scattering is outlined. Author

N72-13439# Joint Publications Research Service, Washington, D.C.
FEASIBILITY OF INCREASING OUTPUT POWER FROM A CO2-N2-He MIXTURE
P. A. Bokhan and Ye. S. Yegorova 16 Dec. 1971 5 p refs
Transl. into ENGLISH from Zh. Prikl. Spektroskopii (Moscow), v. 7, no. 6, Dec. 1971 p 954-956
(JPRS-54720; UDC-621.375.9; CSO-0963/72-S) Avail: NTIS

A nonpinching laser discharge interval of 150 cm was achieved in a 70 mm diameter water cooled tube. The distance between the resonating mirrors was 260 cm. The radiation was removed through a 10 mm opening in the center of the concave mirror. Author

N72-13440*# GTE Sylvania, Inc., Mountain View, Calif. Electro-optics Organization.
LIFE TESTING OF METAL-CERAMIC CO2 LASERS Final Report, Feb. - Oct. 1971
T. S. Fahlen, D. J. Radecki, R. S. Reynolds, and R. Targ Nov. 1971 92 p refs
(Contract NAS5-21606)
(NASA-CR-122313; Rept-465F) Avail: NTIS CSCL 20E

The main qurpose of this program was to determine the life characteristics of nine space-qualified, metal-ceramic CO2 lasers. Lifetimes ranged between about 400 hours to over 2000 hours (the limit of testing) with a high degree of consistency in like groups. In all cases the tubes which had failed could be restored to near their original power by doubling the cathode current for 30 minutes. Periodic rejuvenation allowed operation for the full 2000 hours on all tubes. The failure mechanism appears to involve formation of NiO and C on the nickel cathode emission surface with subsequent absorption of tube gases. Author

N72-13441*# Techtran Corp., Glen Burnie, Md.
ATTENUATION OF LASER RADIATION IN THE ATMOSPHERE
Yu. P. Safronov, Ya. A. Sukhanov, V. A. Poluarshinov, and I. B. Maksyutov Washington NASA Dec. 1971 9 p refs Transl. into ENGLISH from Zh. Prikl. Spektrosk. (USSR), v. 12, no. 3, Mar. 1970 p 450-454
(Contract NASw-2037)
(NASA-TT-F-14081) Avail: NTIS CSCL 20E

The possibility of using lasers for various communication, location and tracking systems is noted. Atmospheric transmission at various zenith angles was measured by recording solar raduation of appropriate wavelengths. The following conclusions were reached: (1) for zenith angles of about 34 deg, the transmission of the whole atmosphere for ruby laser radiation is not less than 0.8; for the helium-neon laser at angles up to 73 deg, the transmission coefficient is 0.6; (2) the possibility of interference by some absorption bands of atmospheric gases is present; and (3) the transmission of the atmosphere in the regions of intense absorption bands is 0.6 to 0.7 for the ruby laser; and 0.5 to 0.6 for the helium-neon laser. Author

N72-13442# Grumman Aerospace Corp., Bethpage, N.Y. System Sciences Section.
APPROXIMATE ANALYSES OF THE REFRACTIVE ATTENUATION OF LASER BEAM INTENSITIES BY TURBULENT ABSORBING MEDIA
M. R. Wohlers Dec. 1971 45 p refs Submitted for publication
(RM-527J) Avail: NTIS

Consideration is given to certain physical phenomena that can attenuate the intensity of a laser beam by refractively spreading or scattering the beam as it propagates. The total attenuation caused by these effects can be well above the usual geometric spreading and absorption losses. Two specific phenomena are analyzed: the nonlinear thermal blooming of the beam and the spreading caused by random variations of the index of refraction of the medium in which the beam is propagating. Reasonably simple analytic expressions that can be used to estimate or set bounds on the extent of the attenuation are obtained for both the transient and the steady-state effects of thermal blooming when the medium is moving relative to the laser beam, and various estimates are also obtained for the turbulence-induced attenuation. Author

N72-13443# National Bureau of Standards, Washington, D.C.
CONSTRUCTION OF A FLASHLAMP-PUMPED DYE LASER AND AN ACOUSTIC-OPTIC MODULATOR FOR MODE LOCKING Final Report
D. A. Jennings and D. L. Baldwin Jul. 1971 35 p refs
(ARPA Order 891)
(AD-7286121; NBS-TN-603) Avail: NTIS GPO HC $1.00 as C13.46:603, Stock no. 030-370867 CSCL 20/5

The design of a flashlamp-pumped dye laser capable of emitting light pulses 500 nsec wide (FWHM) with a risetime of 300 nsec is presented. The energy output in the visible region of light is 1 to 10 mJ with an energy conversion efficiency of about 0.01% at a repetition rate of 30 pps. The design of an acousto-optic modulator used to mode-lock the dye laser by intracavity loss modulation is presented. The laser output for a given cavity length depends on the frequency and voltage applied to the modulator: a 10% - 100% modulated output can be obtained with 1 V rms - 20 V rms, whereas train of light pulses narrower than 0.8 nsec (FWHM) can be obtained with 80 V rms. Author (GRA)

N72-13444# Army Electronics Command, Fort Monmouth, N.J.
A STUDY OF LASER RESONATORS AND MODE-LOCKING
Martin I. Wolfe May 1971 50 p refs
(DA Proj. 1H6-62701-A-448)
(AD-728101; ECOM-3422) Avail: NTIS CSCL 20/5

The first part of the report represents a theoretical study of confocal resonators. The second part consists of a study of mode-locking and techniques that use mode-locked lasers. The report is intended to present a detailed analysis of a confocal resonator in order to illustrate the applicability of the method of analysis for further investigation of resonators for mode-locked lasers. Also the potential of mode-locked lasers for use in a high-bit rate communications system is investigated.
Author (GRA)

N72-13445# RAND Corp., Santa Monica, Calif.
PROPAGATION OF A FOCUSED LASER BEAM IN A TURBULENT ATMOSPHERE
R. F. Lutomirski Jun. 1971 31 p refs
(Contract DAHC15-67-C-0141; ARPA Order 189-1)
(AD-728743; R-608-ARPA; DDC-1) Avail: NTIS CSCL 20/6

A method is given for calculating the performance of a laser system with beam truncated by focusing optics in a turbulent atmosphere. Previous analyses have been limited to vacuum calculations with untruncated beams, and even then have not conserved the irradiance. This approach separates the geometry of the problem (the complex aperture distribution) from the beam propagation. Author (GRA)

N72-13446# TRW Systems Group, Redondo Beach, Calif.
AN ANALYTICAL AND EXPERIMENTAL STUDY OF STRESSES IN TURBINE BLADES USING HOLOGRAPHIC INTERFEROMETRY Final Report, 23 Jun. 1970 - 23 Jun. 1971
R. Aprahamian, K. R. Overoye, D. A. Evenson, and L. D. Hofmeister 23 Jul. 1971 149 p refs

(Contract N00019-70-C-0590)
(AD-728802; AM-71-5) Avail: NTIS CSCL 14/2

The applicability of laser holographic interferometry to the determination of stresses in turbine blades was investigated. Experiments included continuous wave holographic interferometry of a statically loaded blade at both room and elevated temperatures (1400F) and a vibrating blade at room temperature. A finite element computer model of the blade was used to calculate deflections, strains and stresses in the blade in response to the experiment loads. The holographically measured deflections were compared to the computed deflections and found to be in good agreement. Actual stresses were then taken to be those calculated by the computer program. The applicability of holographic techniques to the detection of flaws in hollow turbine blades was also investigated. The methods used did not reveal localized flaws but did reveal the presence of out of tolerance wall thicknesses. The feasibility of obtaining holograms of blades rotating at high speed was investigated analytically and experimentally. Analysis showed that certain optical arrangements or shortened laser pulses were required. Experiments were performed in which holograms were successfully recorded, confirming the analysis and demonstrating that high rates of rotation do not necessarily degrade holographic images.

Author (GRA)

N72-13447# Owens-Illinois, Inc., Toledo, Ohio. Consumer and Technical Products Div.

DAMAGE THRESHOLD STUDIES OF GLASS LASER MATERIALS Semiannual Technical Report, 1 Jan. - 30 Jun. 1971

N. L. Boling, L. Spanoudis, and P. R. Wengert 31 Jul. 1971 111 p refs
(Contract DAHC15-69-C-0303; ARPA Order 1441)
(AD-728467) Avail: NTIS CSCL 20/5

The report discusses surface and particulate damage to laser glass by high power laser pulses. Surface damage is studied through high speed holography. Holograms of damaged samples are taken within a few hundred nanoseconds after damage. The plasmas and acoustic disturbances associated with damage and visible in these holograms are analyzed in detail. The possibility of eliminating damaging particles from laser glass is examined in a theoretical and experimental investigation. Melting of glass under reduced partial pressure of oxygen in platinum is presented as a method for accomplishing this elimination. Also discussed in this report is the design of a high power, high energy, TEM(OO) mode laser to be used in damage studies.

Author (GRA)

N72-13448# Aerospace Corp., El Segundo, Calif. Electronics Research Lab.

LASER CHARACTERISTICS OF NEODYMIUM-DOPED LITHIUM GERMANATE GLASS Technical Report, May 1968 - May 1971

Milton Birnbaum, Curtis L. Fincher, Cortland O. Dugger (AFCRL), John Goodrum (AFCRL), and Herbert Lipson (AFCRL) 15 Aug. 1971 35 p refs
(Contract F04701-71-C-0172)
(AD-729187; TR-0172(9230-10)-2; SAMSO-TR-71-160) Avail: NTIS CSCL 20/5

The spectroscopic characteristics of Nd-doped lithium germanate glass are compared to those of Nd-doped silicate glasses; the laser characteristics of Nd-doped lithium germanate glass are compared to the corresponding properties of Nd-doped glass and YAG samples. The Nd-doped lasers were end pumped using the 5145-A output of pulsed argon ion lasers and oscillated at about 1.06 micrometers at room temperature. This technique enables a precise determination of the pump energy required to reach the oscillation threshold. Threshold energy, output power, spiking, fluorescent conversion efficiency, laser rod losses, and stimulated emission cross sections at 1.06 micrometer are compared. Stimulated emission cross-section values of the Nd:lithium germanate glass obtained by two methods are presented.

Author (GRA)

N72-13449# Arnold Engineering Development Center, Arnold Air Force Station, Tenn.

INVESTIGATION OF LASER RESONANT ABSORPTION FOR GAS DYNAMICS MEASUREMENTS Final Report, 27 Oct. 1969 - 15 Jan. 1971

Frederick M. Shofner (Tenn. Univ., Tullahoma) and Carl S. Helrich (Tenn. Univ., Tullahoma) Aug. 1971 46 p refs
(Contract F40600-70-C-0002; AF Proj. 4344)
(AD-729204; AEDC-TR-71-142) Avail: NTIS CSCL 07/4

A feasibility study of a technique to measure gas densities using resonant scattering of laser light is described. The technique involves the illumination of the gas by a laser beam whose frequency is matched to a natural transition frequency of one species of the gas. The reemitted light is then detected. The density is obtained from the integrated absorption coefficient which is determined by sweeping the laser frequency over the line. A theoretical description is given of line broadening mechanisms. Experimental studies were initiated involving both absorption and reemission of coherent radiation. Author (GRA)

N72-13450# Harry Diamond Labs., Washington, D.C.

ANALYSIS OF COMPLEX LASER CAVITIES

T. J. Gleason Jul. 1971 32 p refs
(DA Proj. 1M2-62301-D-117; HDL Proj. 58332)
(AD-728830; HDL-TM-71-5; AMCMS-Code-522A.12.11300) Avail: NTIS CSCL 20/5

A simple method of analyzing laser cavity eigenmodes in terms of 2-by-2 ray-transfer (or ABCD) matrices is generalized to apply to complex cavities containing intracavity lenses and dielectric laser rods that may exhibit thermally induced focusing. The ray matrix equations are solved for the eigenmode radius and phase front curvature. A FORTRAN program to carry out such an analysis is given. Author (GRA)

N72-13451# Southwest Research Inst., San Antonio, Tex.

A LASER TECHNIQUE FOR CALIBRATION OF PIEZOELECTRIC TRANSDUCERS USED TO MEASURE UNDERWATER SHOCK PRESSURES Final Report

C. E. Edlund, G. F. Munsch, P. J. Pantermuehl, and B. W. Vanzant Jul. 1971 83 p refs
(Contract N00014-66-C-0318; SWRI Proj. 03-1933)
(AD-728978) Avail: NTIS CSCL 14/2

A crossed beam laser Dopplermeter was used to measure particle velocity at an explosively generated shock front in water. The shock front velocity was measured by detecting the time interval required for the shock front to intersect two parallel laser beams a known distance apart. A tourmaline piezoelectric gage was positioned at the same distance from the explosive charge as was the point of intersection of the crossed beam system. The peak shock overpressure as indicated by the tourmaline transducer was the same as that calculated by the product of front velocity times particle velocity times density of the undisturbed water. Although the system is marginal for measuring particle velocity with existing equipment, it is anticipated that normal technological advances will eventually permit such a system to be used to calibrate underwater shock transducers.

Author (GRA)

N72-13452# Naval Research Lab., Washington, D.C.

H2 VACUUM UV LASER RATE COEFFICIENTS Interim Report

A. W. Ali and A. D. Anderson 28 Jul. 1971 21 p refs
(AD-729007; NRL-7282) Avail: NTIS CSCL 20/5

Rate coefficients for electron impact excitations of H2 states relevant to vacuum UV lasers are calculated using calculated or measured dissociation cross sections. In addition, ionization and ground state vibrational excitation rate coefficients are calculated, as well as the rates of energy loss in inelastic electron-molecule collision processes in H2. These rate coefficients are essential to calculations of laser power densities and design considerations. These rates are also needed for calculations of H2 laser produced plasmas essential to controlled fusion problems.

Author (GRA)

N72-13453# Harry Diamond Labs., Washington, D.C.
BEAM DIVERGENCE FOR VARIOUS TRANSVERSE LASER MODES
John S. Kruger Jul. 1971 24 p refs
(HDL Proj. 58332)
(AD-729299; HDL-TM-71-11) Avail: NTIS CSCL 20/5

A theoretical determination of the quantitative effect of transverse laser modes TEM(mn) on beam divergence is reported. Relative beam divergences for the 15 laser modes TEM(00) to TEM(44) are calculated. From the general form for the family of transverse modes in a laser cavity, integrals over the intensity distributions are solved explicitly to obtain the fraction of the total power that is in a circular cross section of the beam. From curves of this fractional power versus radius of cross section, the beam divergence for each higher mode is determined relative to that for the TEM(00) mode. Author (GRA)

N72-13454# Army Missile Command, Redstone Arsenal, Ala. Physical Sciences Directorate.
CO2 LASER PULSING
Albert L. Pardue, Jr. 15 Jul. 1971 116 p refs
(DA Proj. 1T2-62303-A-308)
(AD-729334; RR-TR-71-8) Avail: NTIS CSCL 20/5

A theoretical and experimental analysis of laser mode coupling and reactive Q-switching has been presented. In the forced mode locking situation, the total cavity electromagnetic field intensity E(z,t) was expressed as an expansion of quasi-normal modes which satisfy the boundary conditions at both the fixed and moving mirror. Solutions of the wave equation indicated that the modes of operation were analogous to the phased locked oscillations of the phase-modulated laser. A peak mirror excursion of 1400 angstroms was used to mode lock a CO2 laser. Reactive Q-switching was obtained by modulation of the cavity length with a Mossbauer transducer. Regular Q-switched pulses were obtained at rates between 1 and 60 kilohertz.
Author (GRA)

N72-13455# GTE Labs., Inc., Bayside, N.Y.
HIGH ENERGY PULSED LIQUID LASER Annual Technical Summary Report, 1 Jul. 1970 - 30 Jun. 1971
Harold Samelson, Alexander Lempicki, and Robert Kocher 31 Aug. 1971 72 p refs
(Contract N00014-68-C-0110; NR Proj. 015-630)
(AD-729341; TR-71-826.6) Avail: NTIS CSCL 20/5

The design and fabrication of the component subsystems for two different liquid laser systems, a Q-switched oscillator and a long-pulse oscillator and amplifier, are briefly reviewed. Assembly and testing of the subsystems are described in detail. For the Q-switched oscillator unit, experimental results on the dynamic loss and the dependence of output on flow speed are presented and discussed. Author (GRA)

N72-13456# Army Environmental Hygiene Agency, Edgewood Arsenal, Md.
LASER DISTANCE MEASURING EQUIPMENT USED BY US ARMY TOPOGRAPHIC COMMAND (USATOPOCOM), FEBRUARY - APRIL 1971
David H. Sliney Apr. 1971 15 p
(AD-729346; USAEHA-42-073-71) Avail: NTIS CSCL 20/5

A special study of the potential hazards associated with the use of four types of laser distance measuring equipment used by USATOPOCOM was conducted during February - April 1971. The equipment, used for precise distance measurements over survey lines varying between 5 and 40 km, was found to emit potentially hazardous beams intensities at a range up to 300 m even for momentary viewing. Caution distances at which to limit long-term viewing extended to 9 km. Author (GRA)

N72-13457# United Aircraft Corp., East Hartford, Conn. Research Labs.
RESEARCH INVESTIGATION OF PICOSECOND LASER PULSES Annual Report, 1 Aug. 1970 - 31 Jul. 1971
Anthony J. DeMaria, William H. Glenn, George L. Lamb, Jr., Michael E. Mack, and E. Brian Treacy 31 Jul. 1971 90 p refs
(Contract N00014-66-C-0344; ARPA Order 306)
(AD-729030; K920479-30; Code-000000E0K21) Avail: NTIS CSCL 20/5

The report covers work under contract N00014-66-C-0344 for the period 1 August 1970 to 31 July 1971. Topics discussed include theoretical and experimental work on dynamic spectroscopy of ultrashort light pulses, stimulated scattering effects, nonlinear propagation, organic dye lasers, and flashlamps for organic dye lasers. Author (GRA)

N72-13458# Holobeam, Inc., Paramus, N.J. Laser Products Div.
SECOND HARMONIC GENERATION Semiannual Technical Report
James H. Boyden and Edward G. Erickson 15 May 1971 77 p refs
(Contract N00014-71-C-0044; ARPA Order 306; Holobeam Proj. 3212)
(AD-729681) Avail: NTIS CSCL 20/5

Investigations are being conducted under the subject contract with the objective of producing high average powers at a wavelength of 0.532 microns, with a short pulse and high repetition frequency format. The program objectives are to be achieved by utilizing a high average power CW Nd:YAG laser combined with electro-optic Q-switching technique and mode-locked pulse injection as a source of 1.065 micron radiation to drive a nonlinear crystal. To date, it has been demonstrated that mode-locked pulse injection combined with Q-switching in a CW high power Nd:YAG laser can be made to function reproducibly, creating substantial increases in peak power while yielding substantial enhancement in second harmonic conversion efficiency. The general conclusion that the authors have reached is that in order to produce average powers at 0.53 microns of greater than 20 watts it will be necessary to take steps to alleviate the thermal limitations of the harmonic generating crystals. This can be accomplished through an improvement in the materials themselves and the use of mechanical techniques which either distribute the thermal loading over a larger crystal volume or improve markedly the rate of heat removal. A discussion of these techniques will be presented in the final report. Author (GRA)

N72-13798*# Joint Inst. for Lab. Astrophysics, Boulder, Colo.
THE LUNAR LASER RANGING EXPERIMENT
P. L. Bender, R. H. Dicke (Princeton Univ.), D. T. Wilkinson (Princeton Univ.), C. O. Alley (Maryland Univ.), D. G. Currie (Maryland Univ.), J. E. Faller (Wesleyan Univ.), J. D. Mulholland (JPL), E. C. Silverberg (McDonald Obs.), H. E. Plotkin (NASA. Goddard Space Flight Center), W. M. Kaula (Calif. Univ., Los Angeles) et al *In* JPL Proc. of the Conf. on Exptl. Tests of Gravitation Theories 1 Nov. 1971 p 178-181 refs (See N72-13776 04-30)
Avail: NTIS CSCL 20E

N72-13799*# Paris Univ. (France).
THE ACCURACY OF LASER TRACKING
J. E. Blamont *In* JPL Proc. of the Conf. on Exptl. Tests of Gravitation Theories 1 Nov. 1971 p 182-189 refs (See N72-13776 04-30)
Avail: NTIS CSCL 20E

N72-13413*# Little (Arthur D.), Inc., Cambridge, Mass.
THE APOLLO 11 LASER RANGING RETRO-REFLECTOR ARRAY
John E. McCullough *In* NASA. Goddard Space Flight Center 5th Aerospace Mech. Symp. 1971 p 171-175 Supported by NASA (See N72-13391 04-15)
Avail: NTIS CSCL 20E

17 MATERIALS, METALLIC

Includes cermets; corrosion; physical and mechanical properties of materials; metallurgy; and applications as structural materials. For basic research see: 06 Chemistry. For related information see also: 18 Materials, Nonmetallic; and 32 Structural Mechanics.

N72-13459 National Lending Library for Science and Technology, Boston Spa (England).
REACTIONS BETWEEN ELECTRONS AND IONS IN METALS
E. S. Filippov 1971 9 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Chernaya Met. (Moscow), v. 3, 1971 p 110-113
(NLL-M-21064-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

The Couloxb interaction is considered between ions and a valence electron with a quasi-continuous energy spectrum between E sub max and E sub min and a volume between V sub max and V sub min, which are governed by the boundary position of the valence electron from the radius r sub i of an ion to the radius r sub a of an atom respectively. Within these limits of energy and volume a space V and an energy epsilon are allocated to each valence electron. The effective charge on an electron is determined. Energies of ionization and sublimation are calculated for univalent and multivalent metals as functions of Z sub ef, and the Fermi energy is claculated as the function Z = Z sub e - Z sub ef.
Author

N72-13460 National Lending Library for Science and Technology, Boston Spa (England).
CALCULATING THE SOLUBILITY OF HYDROGEN IN MOLTEN ALLOYS OF NICKEL WITH IRON, GOLD, COBALT AND COPPER
M. S. Petrushevskii and P. V. Geld [1971] 9 p refs Transl. into ENGLISH from Izv. Vysshikh Uchebn. Zavedenii, Chernaya Met. (Moscow), v. 2, 1971 p 9-13
(NLL-M-21033-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

A method is proposed for calculating the solubility of hydrogen in molten metallic alloys with characteristic deviations from the laws for ideal solutions. Short-range order and micro-heterogeneous structure of the molten alloys are allowed for in the calculations. The expressions obtained are verified for molten alloys of nickel with iron, gold, cobalt and copper, covering wide ranges of concentration and temperature. The calculated data agree well with the results of experiments.
Author

N72-13461 National Lending Library for Science and Technology, Boston Spa (England).
CALCULATING THE HIGH-SPEED AND STRAIN HARDENING OF METAL DURING PRESSURE TREATMENT FROM THE RESULTS OF TESTS
G. G. Tyulenev and S. N. Vysokovskii [1971] 4 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Chern. Met. (Moscow), no. 3, 1971 p 65-66
(NLL-M-21057-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

The conditions for modelling the effects of high speed and strain hardening on the resistance of metal to deformation during pressure treatment are considered; cylindrical testpieces were used. When the resistance of metal to plane deformation is determined from the results of tests on cylindrical testpieces, their deformation is bound to be about 9% higher and the rate of deformation of testpieces will be about 7 to 15% higher in the case of reductions of up to 20%
Author

N72-13462 National Lending Library for Science and Technology, Boston Spa (England).
MICROSTRUCTURE AND PROPERTIES OF ALUMINUM ALLOYS AFTER RAPID SOLIDIFICATION. 2: EXTENSION OF SOLID SOLUBILITY, EFFECT OF THERMAL TREATMENT, MECHANICAL PROPERTIES
P. Furrer and H. Warlimont [1971] 33 p refs Transl. into ENGLISH from Z. Metall. (West Germany), v. 62, no. 2, Feb. 1971 p 100-112
(NLL-M-20884-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 4 NLL photocopy coupons

After rapid solidification metastable extension of the mixed crystal zone was established in a number of binary Al alloys whose equilibrium diagram shows a limited solubility range in the solid condition. The possibility of metastable supersaturation of Al-rich alloys with additional alloying elements which have unlimited miscibility in the melt seems to depend solely on the applied cooling rate. In the systems examined so far one has failed to obtain super-saturation only in Al Ca and in AlZn. It was not possible to retain more than Zn 43.5% in solution with quenching, which is approx. 1.3 times lower than maximum solid solubility at eutectic temperature. A further increase of the concentration in the melt led to a decrease of solubility. Author

N72-13463 National Lending Library for Science and Technology, Boston Spa (England).
A MECHANISM OF GOLD DIFFUSION INTO SILICON
Y. Hayashi, Y. Tarui, and T. Komuro [Jul. 1971] 23 p refs Transl. into ENGLISH from Denki Shikensho Iho (Tokyo), v. 33, no. 6, 1969 p 66-72
(NLL-M-20863) Avail: Natl. Lending Library, Boston Spa Engl.: 3 NLL photocopy coupons

The mechanism of gold diffusion into silicon epitaxial wafers is discussed. The explanation is offered that gold first reaches the whole silicon wafer in a short time, through dislocations, and is then changed into electrically active substitutional atoms. The time dependency of the change of resistivity when electrically inactive gold atoms are changed into the substitutional species, is explained better by this mechanism, than by a diffusion time dependence.
Author

N72-13464 National Lending Library for Science and Technology, Boston Spa (England).
THE METALLOGRAPHY OF ALUMINIUM
G. Gonschior and E. Weiland [1971] 7 p refs Transl. into ENGLISH from Neue Huette (Leipzig), v. 15, no. 4, Apr. 1970 p 245-247
(NLL-M-20839-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

The application of a metallographic anodizing technique is reported whose aim was to carry out dislocation etching with a minimum delay and to reveal microstructure details of samples of Al 99.99 and Al 99.7.
Author

N72-13465# Royal Aircraft Establishment, Farnborough (England).
THE FATIGUE PROPERTIES OF TITANIUM AND TITANIUM ALLOYS. PART 7: ADDENDUM AND APPENDIX TO PARTS 1 TO 6
M. Hempel Jul. 1971 18 p refs Transl. into ENGLISH from Draht (West Germany), v. 18, no. 3, 1967 p 154-158
(RAE-Lib-Trans-1596-Pt-7; UDC-669.295; BR26899; UDC-669.295.5; UDC-539.388.1) Avail: NTIS

Recent data on the effect of cold working, temperature and prestressing on the fatigue strength of titanium and titanium alloys are briefly reviewed, supplementing earlier results. A report is then given of the following properties of titanium materials: the fatigue strength under variable mean stress, the fretting corrosion fatigue strength, the mechanisms of deformation under fatigue stressing, the resistance to alternating temperature stressing and material damping. Titanium materials suitable for structural fixing components such as fasteners or rivets, glued joints and wires and springs are discussed and finally the notch sensitivity of titanium under static loading is mentioned. Author

N72-13466# Technische Univ., Berlin (West Germany).
DIFFERENTIAL SCATTERING BEHAVIOR AND RECOIL EFFECTS Ph.D. Thesis
Karl-Ludwig Zorn 1970 73 p refs In GERMAN
(D-83) Avail: NTIS

Considered are elastic and general scattering properties of aluminum and gold foils of differing thicknesses at 30 KeV electron bombardment. Elastic scattering intensities are calculated as function of layer thickness and scattering angle and it is shown that foil thicknesses with maximal scattering properties are equal to the inelastic free path lengths. The elastic scattering part of the electron backscattering on a solid target comprises about 4% of the overall scattering. Measurements of median backscattering losses at small scattering angles did not produce any deviations from the scattering laws for large angles.
Transl. by G.G.

N72-13467# Eidgenossische Technische Hochschule, Zurich (Switzerland).
DIFFUSION IN CONDUCTIVE MULTIPLE LAYERS AND SOFT SOLDERS AT TEMPERATURES BETWEEN 23 AND 212 DEGREES C Ph.D. Thesis [DIFFUSION IN GALVANISCH AUFGEBRACHTEN SCHICHTEN UND WEICHLOTEN BEI TEMPERATUREN ZWISCHEN 23 UND 213 C]
Martin Creydt 1971 122 p refs In GERMAN
(Diss-4616) Avail: NTIS

Phenomena observed during low temperature diffusion runs on thin galvanic layers and on multilayer combinations of soft solders with a number of base and noble metals are reported. The experiments were evaluated with an electron microprobe. Chemical diffusion coefficients were calculated for several combinations of tin with other metals at various temperatures. A comprehensive computer program using finite-difference methods for the simulation of some cases of multicomponent, multilayer diffusion is presented, along with instructions for its use. Author

N72-13468*# General Electric Co., Evendale, Ohio. Aircraft Engine Group.
DEVELOPMENT OF SUPERALLOYS BY POWDER METALLURGY FOR USE AT 1000 - 1400 F
C. D. Calhoun Nov. 1971 92 p refs
(Contract NAS3-13202)
(NASA-CR-72968; R71AEG248) Avail: NTIS CSCL 11F

Consolidated powders of four nickel-base superalloys were studied for potential application as compressor and turbine discs in jet engines. All of the alloys were based on the Rene' 95 chemistry. Three of these had variations in carbon and A1203 contents, and the fourth alloy was chemically modified to a higyer volume fraction. The A1203 was added by preoxidation of the powders prior to extrusion. Various levels of four experimental factors (1) alloy composition, (2) grain size, (3) thermomechanical processing, and (4) room temperature deformation plus final age were evaluated by tensile and stress rupture testing at 1200 F. Various levels of the four factors were assumed in order to construct the statistically-designed experiment, but the actual levels investigated were established in preliminary studies that preceded the statistical process development study. Author

N72-13469*# Boeing Co., Seattle, Wash. Research and Engineering Div.
INVESTIGATION OF FLAW GEOMETRY AND LOADING EFFECTS ON PLANE STRAIN FRACTURE IN METALLIC STRUCTURES Final Report
L. R. Hall and R. W. Finger 18 Dec. 1971 308 p refs
(Contract NAS3-12016)
(NASA-CR-72659) Avail: NTIS HC $6.00/MF $0.95 CSCL 11F

The effects on fracture and flaw growth of weld-induced residual stresses, combined bending and tension stresses, and stress fields adjacent to circular holes in 2219-T87 aluminum and 5Al-2.5Sn(ELI) titanium alloys were evaluated. Static fracture tests were conducted in liquid nitrogen; fatigue tests were performed in room air, liquid nitrogen, and liquid hydrogen. Evaluation of results was based on linear elastic fracture mechanics concepts and was directed to improving existing methods of estimating minimum fracture strength and fatigue lives for pressurized structure in spacecraft and booster systems. Effects of specimen design in plane-strain fracture toughness testing were investigated. Four different specimen types were tested in room air, liquid nitrogen and liquid hydrogen environments using the aluminum and titanium alloys. Interferometry and holograph were used to measure crack-opening displacements in surface-flawed plexiglass test specimens. Comparisons were made between stress intensities calculated using displacement measurements, and approximate analytical solutions. Author

N72-13470*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ION AND LASER MICROPROBES APPLIED TO THE MEASUREMENT OF CORROSION-PRODUCED HYDROGEN ON A MICROSCOPIC SCALE
Hugh R. Gray Washington Dec. 1971 22 p refs
(NASA-TN-D-6521; E-6546) Avail: NTIS CSCL 07D

An ion microprobe and a laser microprobe were used to measure concentrations of corrosion-produced hydrogen on a microscopic scale. Hydrogen concentrations of several thousand ppm were measured by both analytical techniques below the fracture surfaces of hot-salt stress-corroded titanium alloy specimens. This segregation of hydrogen below fracture surfaces supports a previously proposed theory that corrosion-produced hydrogen is responsible for hot-salt stress-corrosion embrittlement and cracking of titanium alloys. These advanced analytical techniques suggest great potential for many areas of stress-corrosion and hydrogen embrittlement research, quality control, and field inspection applications. Author

N72-13471*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
OXIDATION OF TD NICKEL AT 1050 C AND 1200 C AS COMPARED WITH THREE GRADES OF NICKEL OF DIFFERENT PURITY
Carl E. Lowell, Salvatore J. Grisaffe, and Daniel L. Deadmore Washington Jan. 1972 23 p refs
(NASA-TM-X-2462; E-6577) Avail: NTIS CSCL 11F

The isothermal oxidation of three nickels of different purity, Ni-200, Ni-270, and JM-Ni, was compared with that of TD-Ni in air at 1050 and 1200 C. The samples were oxidized as ground, as polished, or as annealed and polished. Weight change, metal loss, scale thickness, oxide morphology, and scale texture were determined. In degree of oxidation, TD-Ni was nearly the same as the higher purity materials, Ni-270 and JM-Ni; and less pure Ni-200 oxidized more than the others. However, in microstructure and scale texture the TD-Ni more closely resembled Ni-200. Grinding only charged the texture of the oxides of Ni-200 and TD-Ni. Author

N72-13472# Royal Aircraft Establishment, Farnborough (England).
EFFECT OF TEMPERATURE ON THE DEFORMATION BEHAVIOUR OF ALUMINIUM AND ALUMINIUM-MAGNESIUM ALLOYS
Borchers. H., H. M. Tensi, and H. Ehrhardt May 1971 20 p refs Transl. into ENGLISH from Aluminium (West Germany), V. 44, no. 9, 1968 p 546-550
(RAE-Lib-Tran-1415; BR27310) Avail: NTIS

The deformation behaviour of pure aluminium and aluminium-magnesium alloys was studied in uniaxial stressing. The alloy consisted of 0.2 to 7% by weight magnesium in Al 99.99. The distribution of magnesium atoms was varied by different cooling rates. The tensile specimens, with grain size between 10,000 microns per sq. meter were tested at temperatures between -70 and 290 C. The yield stress behaviour

is considered in an earlier report. The relations between experimental variables and the values which characterise the deformation capacity of the investigated materials are considered. Author

N72-13473# Cornell Univ., Ithaca, N.Y. Materials Science Center.
THERMOMAGNETIC EFFECTS IN NORMAL AND SUPERCONDUCTING INDIUM AND NIOBIUM Ph.D. Thesis
Craig Hamman Stephan Jun. 1971 109 p refs Sponsored in part by ARPA
(AT(30-1)-2150)
(NYO-2150-71; Rept-1545) Avail: NTIS

Measurements of the Hall effect, its thermal analog the Righi-Leduc effect, and thermal magnetoresistance were made in In and Nb. The Hall and Righi-Leduc effects in large magnetic fields in polycrystalline In at 2.5 to 8 K followed a generalized Wiedemann-Franz law. The Righi-Leduc coefficient in oriented In single crystals at low magnetic fields changes sign as the field is increased from zero. The ratio of relaxation times of the third-zone electron-like carriers to the second-zone holes is calculated to be approximately 1.2. In the mixed state of Nb, the thermal resistance has a maximum near H sub c1, decreasing sharply at H sub c2. The ratio of the transverse-to-longitudinal temperature gradient is nearly constant for fields of 0.2 to 0.8 H sub c2, but is much smaller than the normal-state value at H sub c2. No unusual behavior is observed in the normal state. The thermal resistance follows the expected behavior in the intermediate state of polycrystalline In. The Righi-Leduc also coefficient changes sign. NSA

N72-13474# Union Carbide Corp., Oak Ridge, Tenn. Y-12 Plant.
RESIDUAL STRESS ANALYSIS BY X-RAY DIFFRACTION (ANALYSIS OF THIN SHEET TITANIUM ALLOY)
W. E. Baucum 11 May 1971 23 p refs Presented at Soc. for Exptl. Stress Analysis, Salt Lake City, 18-21 May 1971
(Contract W-7405-eng-26)
(Y-DA-3741) Avail: NTIS

A technique is described for measuring the residual stresses in thin, contoured sheets of titanium alloy (Ti-6 wt % Al-4 wt % V) by X-ray diffraction. The use of the stress camera in the normal incident beam mode with a stress reference standard is presented. Specimen preparation, diffraction peak location, determination of the ratio of Young's modulus to Poisson's ratio, and precision of the measurements are covered. Use of the scanning microdensitometer to evaluate the diffraction films and a method of filtering out unwanted titanium fluorescent radiation are presented. Applications include measurement of stresses in formed and machined samples of various types of bends. Measurements were made on one group of samples before and after a 1,300 F heat treatment. Author (NSA)

N72-13475# Atomics International, Canoga Park, Calif.
LIQUID METAL ENGINEERING CENTER (LMEC) Semiannual Technical Progress Report, Jul. - Dec. 1970
Dec. 1970 113 p
(Contract AT(04-3)-700)
(LMEC-71-1) Avail: NTIS

Results of research and test work are reported on Na-water reactions, operation of Na components test installation, operation of precision control and handling equipment in liquid Na, materials compatibility in Na, instrumentation, chemistry and metallurgy of materials used in Na, operation of Na-heated boilers, operation of intermediate heat exchangers, and operation of Na test loops. NSA

N72-13476# Nagoya Univ. (Japan). Inst. of Plasma Physics.
EFFECT OF WORKING ON THE CHANGE OF PERMEABILITY (MU) OF AUSTENITIC STAINLESS STEELS
Setsuya Fujiwaka Mar. 1970 27 p refs In JAPANESE
(IPPJ-DT-20) Avail: AEC Depository Libraries

The change of permeability (mu) by partial machining and welding was measured. The measurement is based on change of magnetic resistance caused by mu of samples. The change of magnetic flux was measured with a fluxmeter of electron tube type. Conventional SUS-27, SUS-32, SUS-41 and SUS-42 were used as samples. The following treatments were applied to these samples; cold working, silver soldering and welding, use of different filler rods and solid solution treatment. Results showed that mu of the welded samples decreased in the order of argon arc welding (one layer), argon arc welding (two layers) and alternating current arc welding. This is due to difference in welding time among them and degree of fracture of austenite phase. NSA

N72-13477# Midwest Research Inst., Kansas City, Mo.
THE INITIATION AND GROWTH OF FATIGUE CRACKS IN FILAMENT-REINFORCED ALUMINUM ALLOYS Technical Report, 1 Apr. 1970 - 28 Feb. 1971
J. R. Hancock Wright-Patterson AFB, Ohio. AFML Mar. 1971 39 p refs
(Contract F33615-70-C-1284; AF Proj. 7353)
(AD-728648; AFML-TR-71-82; Task-735301) Avail: NTIS CSCL 11/4

The low-cycle fatigue behavior of filamentary composites of 1235 aluminum-beryllium, 6061 aluminum-beryllium, and 7075 aluminum-boron were compared. The effects of the strength and ductility of the filaments and matrix, and the role of interfaces on fatigue hardening, and on fatigue-crack initiation and growth were evaluated to develop guidelines for the design of fatigue-resistant composites. Generally, brittle filaments, a ductile matrix, weak interfacial bonds, and a large modulus difference between constituents are the factors which lead to greater fatigue resistance in filament-reinforced metals. The observed modes of fatigue-crack growth confirmed the theoretical predictions of the effects of stress distribution at a crack tip at an interface, and extended the applicability of these predictions to filamentary composites. Author

N72-13478# Army Foreign Science and Technology Center, Charlottesville, Va.
THE CORRELATION BETWEEN EXOELECTRONIC EMISSION AND SUSCEPTIBILITY TO CORROSION UNDER STRESS IN IRON ALLOY
L. K. Zamiryakin, L. T. Shepelina, and E. M. Gutman 15 Jul. 1971 11 p refs Transl. into ENGLISH from Fiz.-Khim. Mekh. Mater. (Ukrainia SSR, v. 5, no. 1, 1969
(AD-728149; FSTC-HT-23-841-71; T702301-2301) Avail: NTIS CSCL 11/6

Measurement of exoelectronic emission in Fe-Ni alloys shows greater emission as Ni content decreases corrosion under stress is also inversely related to Ni content. The effect is explained as due to the nature of emission centers--points at which shear lines reach the surface. Author (GRA)

N72-13479# Pennsylvania State Univ., University Park. Materials Research Lab.
HYDROTHERMAL OXIDATION OF ALUMINUM
Frank Dachille, Eugene W. White, and Paul D. Gigl 6 Aug. 1971 41 p refs
(Contract N00014-67-A-0385-02; NR Proj. 032-502)
(AD-728037; TR-7) Avail: NTIS CSCL 11/6

Aluminum surfaces were oxidized under hydrothermal conditions over a pressure range of up to 40,000 psi and temperatures to 500C. The oxidized surfaces were examined by X-ray diffraction, soft X-ray emission spectroscopy, and scanning electron microscopy (SEM). Crystalline product phases formed on the surfaces over the p-t range were bayerite, boehmite, and corundum, each in a fairly well defined region. Along the 10,000 psi isobar bayerite formed up to 150C, boehmite from 150C to 425C, and corundum above 425C, and along the 30,000 psi isobar the temperatures are higher by 25C in each case. SEM revealed the formation of dense mat surfaces, amorphous to

X-rays, in early stages of treatment in the bayerite and boehmite reaction regions, with those formed in the bayerite region being denser and of finer texture. Preliminary tests have shown that films formed under the bayerite conditions are more resistant to corrosive attack then 'boehmite' type films. Author (GRA)

N72-13480# Army Foreign Science and Technology Center, Charlottesville, Va.
THIN FILMS AND THEIR UTILIZATION IN RADIO-MEASUREMENT TECHNOLOGY Ph.D. Thesis
V. A. Yugov 30 Jun. 1971 116 p refs Transl. into ENGLISH from Tonkiye Plenki i ikh Primeniye v Radiozmeritelnoi Tekhnike, Ph.D. Thesis, Moscow, Bur. of Std. Publ., 1964
(AD-728735; FSTC-HT-23-856-71; T702301-2301) Avail: NTIS CSCL 11/6

A general survey of techniques used in the production of thin metal films is presented. The subject is treated theoretically and practically. Utilization of thin films in the construction of bolometers, tensometers, and other instruments is described. Author (GRA)

N72-13481# Boston Univ., Mass. Dept. of Physics.
CRITICAL POINT PHENOMENA AND PROPERTIES OF METALS Final Report
George O. Zimmerman and Charles E. Chase 26 Jul. 1971 11 p refs
(Grant AF-AFOSR-1770-69; AF Proj. 9763-03)
(AD-728686; AFOSR-71-2137TR; Rept-61102F; Rept-681306) Avail: NTIS CSCL 11/6

The progress consisted mainly of the construction and testing out of experimental apparatus. Author (GRA)

N72-13482# Connecticut Univ., Storrs. Dept. of Metallurgy.
DEPENDENCE OF FATIGUE LIFE OF 5052 ALUMINUM IN AQUEOUS SODIUM CHLORIDE ON SPECIMEN POTENTIAL
Owen F. Devereux Apr. 1971 15 p refs
(Contract F44620-69-C-0011; AF Proj. 7921)
(AD-728712; UC-Met-3-71; AFOSR-71-1075TR) Avail: NTIS CSCL 11/6

The aluminum alloy 5052 was subjected to reverse bending fatigue in 3.5% aqueous NaCl under controlled potential. Under anodic polarization a low lifetime was observed, independent of potential; under cathodic polarization lifetime increased with increasing negative potential. Maximum lifetime observed was similar to that seen in distilled water. Lifetime without specimen potential control was only slightly higher than that seen under anodic polarization. A comparison is made to published stress corrosion data. Author (GRA)

N72-13483# Battelle Memorial Inst., Columbus, Ohio. Defense Metals Information Center.
DIRECTORY OF HIGH TEMPERATURE CORROSION RESEARCH: ORGANIZATIONS, INVESTIGATOR, AND PROGRAMS
Jan. 1971 27 p
(Contract F33615-71-C-1067)
(AD-728674; DMIC-Memo-254) Avail: NTIS CSCL 11/6

The directory lists the organizations, together with the investigators and the research areas (or specific programs) in which they are working, alphabetically by countries. There are 178 organizations from eleven NATO countries included. A category index indicates the high-temperature corrosion research areas in which the various organizations are conducting research. The two research areas currently receiving the most attention are (1) material behavior under corrosion and (2) reaction kinetics and diffusion processes, in which 119 and 97 organizations, respectively, are working. An alphabetical index of investigators includes approximately 240 names. Author (GRA)

N72-13484# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
DETERMINATION OF THE THERMAL CONDUCTIVITY OF METALS AND ALLOYS BY THE METHOD OF ELECTRICAL HEATING OF FINE HOMOGENEOUS RODS TAKING HEAT LOSSES INTO ACCOUNT
Yu. M. Lebedev and A. V. Prograshchenko 15 Jul. 1971 16 p refs Transl. into ENGLISH from Fiz. Khim. Orab Mater. (Moscow), no. 3, 1968 p 40-45
(AD-729077; FTD-HT-23-886-71; DIA-Task-T69-04-9; UR/0472-68-000-003) Avail: NTIS CSCL 11/6

A new direction is being suggested for the measurement of the heat capacity of metals and alloys in samples in the form of thin rods with constant cross section over their entire length, heated by the indirect passage of an electric current through them, with consideration of heat losses into the surrounding medium. Calculation formulas are given for the determination of the heat capacity in cases of heating and cooling in any kind of medium and in a vacuum. Author (GRA)

N72-13485# North American Rockwell Corp., Los Angeles, Calif.
MECHANICAL BEHAVIOR OF HIGH STRENGTH BETA TITANIUM ALLOYS
Kanji Ono, L. A. Rosales, S. Motokura, and A. W. Sommer Aug. 1971 24 p refs Presented at the Intern. Conf. on Mech. Behavior of Mater., Kyoto, Japan, 15-20 Aug. 1971 Prepared jointly with Calif. Univ., Los Angeles
(Contract N00014-67-C-0439; NR Proj. 031-718)
(AD-729145; NA-71-754; TR-6) Avail: NTIS CSCL 11/6

Thermomechanical treatments of Beta-III (11.5 Mo-6 Zr-4.5 Sn-Ti) and 18 Mo-Ti were performed in order to study microstructure-mechanical property relationships. Transmission electron microscopy was employed to delineate the effects that prior cold work and multiple aging steps produce in microstructure. The optimum combination of strength (230 ksi) and good ductility/toughness is obtained by cold work of the Beta-phase followed by pre-aging in the omega & Beta region and final aging in the alpha & Beta region to produce an extremely fine distribution of alpha-particles in the Beta-matrix. Results of an internal friction study on a series of Beta-Ti alloys containing various amounts of Mo and V with and without plastic deformation are also presented in order to describe the fundamental nature of the Beta-omega transformation. These results indicate the transformation to be of the 'atom shuttle' or displacive type. Author (GRA)

N72-13953# Royal Swedish Academy of Engineering Sciences, Stockholm.
EXTREME WORKING CONDITIONS
In its Develop. in Res. and Technol. during 1970 1970 p 93-97 refs In SWEDISH (See N72-13942 04-34)
Avail: NTIS; Almqvist & Wiksell, Stockholm: 25 Kr

N72-13954# Royal Swedish Academy of Engineering Sciences, Stockholm.
COMPOSITE MATERIALS
In its Develop. in Res. and Technol. during 1970 1970 p 97-106 refs In SWEDISH (See N72-13942 04-34)
Avail: NTIS; Almqvist & Wiksell, Stockholm: 25 Kr

N72-13955# Royal Swedish Academy of Engineering Sciences, Stockholm.
NEW ALLOYS
In its Develop. in Res. and Technol. during 1970 1970 p 106-108 refs In SWEDISH (See N72-13942 04-34)
Avail: NTIS; Almqvist & Wiksell, Stockholm: 25 Kr

18 MATERIALS, NONMETALLIC

Includes corrosion; physical and mechanical properties of materials (e.g., plastics); and elastomers, hydraulic fluids, etc. For basic research see: 06 Chemistry. For related information see also: 17 Materials, Metallic; 27 Propellants; and 32 Structural Mechanics.

N72-13486 National Lending Library for Science and Technology, Boston Spa (England).
RATE AT WHICH TEPHROITE PENETRATES SPECIMENS OF WELDING MATERIALS
B. V. Tsarevskii, V. G. Babkin, and S. I. Popel [1971] 11 p refs Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved, Chern Met. (Moscow), no. 2, 1971 p 5-8
(NLL-M-21032-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 2 NLL photocopy coupons

The rates at which tephroite penetrates porous specimens of magnesium oxide, corundum, quartz, chrome-magnesite, zirconium silicate and brucite have been studied, also the effects of the size of the pores, the temperature and the substance of which specimens are made on the constant of speed of impregnation. The quadratic relationship of the depth of penetration of the molten substance to time was confirmed in all the experiments. Impregnation speed constants calculated using an equation previously proposed are compared with experimental values. It is established that the rate of impregnation at low temperatures in basically restricted by wetting; at 1400-1550 C the process becomes one of viscous flow. The addition of 5% of waterglass, ethyl silicate or loam (up to 9%) to specimens of MgO is accompanied by a 50-400% increase in the rate of impregnation, while the addition of 5% of magnesium phosphate is accompanied by a reduction of about 63% in the rate of impregnation. Author

N72-13487 National Lending Library for Science and Technology, Boston Spa (England).
THE MECHANICAL PROPERTIES OF HIGHLY CROSS-LINKED COATING FILMS
Andre Toussaint [1971] 21 p refs Transl. into ENGLISH from Farbe Lack (Hanover), v. 76, no. 9, Sep. 1970 p 872-884
(NLL-M-20828-(5828.4F); NLL-1225/ERS/71) Avail: Natl. Lending Library, Boston Spa, Engl.: 2 NLL photocopy coupons

It is possible, using graphical master curves, to make statements about the mechanical properties of highly crosslinked lacquer films with different rates of deformation and at different temperatures, some of which may be difficult to attain experimentally. Stress-strain and relaxation curves are presented and discussed. These are based on the general form of a mathematical relationship known as the WLF equation. The time-temperature superposition principle is considered in relation to viscoelastic behavior. Epoxy polyamide and polyurethane systems were investigated, and the results of stress relaxation and rupture tests are presented. Author

N72-13488 National Lending Library for Science and Technology, Boston Spa (England).
EFFECT OF CRYSTALLINE GRAIN SIZE ON THE PHYSICAL PROPERTIES OF CERAMIC BARIUM TITANATE
A. V. Turik and V. D. Komarov 22 Sep. 1971 4 p refs Transl. into ENGLISH from Izv. Vuz. Fiz. (USSR), v. 9, 1970 p 138-140
(NLL-NSTIC-Trans-2499-(6180.59)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

A study of the dielectric properties of chemically pure ceramic $BaTiO_3$ having significantly different grain sizes was undertaken. The types of recrystallization and the nature of the domain structure of the ferroelectric ceramic were considered. The reasons for the effects observed are also discussed. It was concluded that the existence of anomalous properties in a fine-grained ceramic is due to grains in which the 90 deg domain walls are absent, as well as to the conditions of screening spontaneous polarization by free charges. K.P.D.

N72-13489 National Lending Library for Science and Technology, Boston Spa (England).
SOME POSSIBILITIES FOR THE LESSENING OF WEAR BY STRATIFICATION
S. Steinhauser 17 Sep. 1971 24 p refs Transl. into ENGLISH from East German report Presented at the ZIF Colloquy, East Germany, 1968
(NLL-T-6946-(5809.95)) Avail: Natl. Lending Library, Boston Spa, Engl.: 2 NLL photocopy coupons

A working procedure for the production of hard metal (particularly carbide) strata using electrophoresis and sintering is discussed. Methods for producing plasma-sprayed coatings are also considered. Friction wear behavior was examined, and the results of the measurements are presented. K.P.D.

N72-13490# British Glass Industry Research Association, Sheffield (England).
THE CHEMICAL DURABILITY OF GLASS: A REVIEW OF TEST METHODS AVAILABLE
W. W. Fletcher 8 Feb. 1971 11 p *Its* Inform. Circ. No. 96
Avail: NTIS

A list of the test procedures, standards, and classifications used to determine the chemical resistance of glass is presented. The data include company, internationally agreed, and national standards. Glass resistance to water, acids, and alkali environments is emphasized. E.H.W.

N72-13491*# Manlabs, Inc., Cambridge, Mass.
INVESTIGATION OF THE FRACTURE MECHANICS OF BORIDE COMPOSITES
Larry Kaufman, Edward V. Clougherty, and Harvey Nesor Jul. 1971 106 p refs
(Contract NASw-2088)
(NASA-CR-124732) Avail: NTIS CSCL 11D

Fracture energies of WC-6Co, Boride 5 (ZrB_2+SiC), Boride 8($ZrB_2+SiC+C$) and Boride 8-M2($ZrB_2+SiC+C$) were measured by slow bend and impact tests of notched charpy bars. Cobalt bonded tungsten carbide exhibited impact energies of 0.76 ft-lb or 73.9 in-lb/square inch. Boride 5 and the Boride 8 exhibit impact energies one third and one quarter of that observed for WC-6Co comparing favorably with measurements for SiC and Si_3N_4. Slow bend-notched bar-fracture energies for WC-6Co were near 2.6 in-lb/square inch or 1/20 the impact energies. Slow bend energies for Boride 8-M2, Boride 8 and Boride 5 were 58%, 42% and 25% of the value observed for WC-6Co. Fractograph showed differences for WC-6Co where slow bend testing resulted in smooth transgranular cleavage while samples broken by impact exhibited intergranular failures. By contrast the boride fractures showed no distinction based on testing method. Fabrication studies were conducted to effect alteration of the boride composites by alloying and introduction of graphite cloth. Author

N72-13492*# TRW Systems Group, Redondo Beach, Calif.
THE DEVELOPMENT OF AUTOCLAVE PROCESSABLE, THERMALLY STABLE ADHESIVES FOR TITANIUM ALLOY AND GRAPHITE COMPOSITE STRUCTURES Final Report, 7 Sep. 1970 - 7 Sep. 1971
R. W. Vaughan and R. J. Jones Dec. 1971 59 p refs
(Contract NAS1-9532)
(NASA-CR-112003) Avail: NTIS CSCL 11A

The A-type polyimide adhesive resin P11B was modified by use of mixed diamines (thio-dianiline and meta phenylene diamine) which provided the desired autoclave processability. This new resin was termed P11BA. It was shown that copolymeric blends of P11BA and Amoco AI-1137 amide-imide resin provided improved adhesive properties when autoclave processed over the properties obtained previously by press bonding with P11B based copolymeric blended adhesives. Properties of bonded assemblies are presented for long-term aging at both elevated and low temperatures, and also stress-rupture tests at elevated temperature. Author

N72-13493*# Space Ordnance Systems, Inc., Saugus, Calif.
EVALUATION OF EPOXY SYSTEMS FOR USE IN SBASI
T. J. Coultas 1 Nov. 1971 70 p
(Contract NAS9-12085; SOS Order 3409)
(NASA-CR-115270; SOS-Doc-7827) Avail: NTIS CSCL 11D

The purpose of the test program was to evaluate the performance of different epoxy systems as replacements for existing epoxy systems in the SBASI. The three areas of investigation were the connector shell potting, the epoxy tape under the charge cup, and the epoxy impregnated fiberglass over the output charge. Factors considered, in addition to performance, were availability, shelf life, pot life, and effect on producibility and cost. Author

N72-13494*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
EFFECTS OF THERMAL AND ENVIRONMENTAL EXPOSURE ON THE MECHANICAL PROPERTIES OF GRAPHITE/POLYIMIDE COMPOSITES
M. P. Hanson and T. T. Serafini Dec. 1971 14 p refs
(NASA-TN-D-6604; E-6497) Avail: NTIS CSCL 11D

Composites were exposed in circulating and static air environments up to 589 K for a maximum of 1000 hours. Composites of HT-S, HM-S, Thornel 50S, and Fortafil 5-Y fiber and a new addition type polyimide resin were laminated in a matched-die mold. Flexural strengths, flexural modulus, and interlaminar shear strengths were determined at 297, 533, and 598 K after various durations of exposure. Composite and fiber weight loss characteristics were determined by isothermal gravimetric analysis in air. Properties of composites exposed and tested at the environment temperatures were compared with those determined under short-term exposure. A new short beam interlaminar shear fixture is described. Environmental effects of long-term ambient temperature exposure on the elevated temperature mechanical properties of graphite/polyimide composites are presented. Author

N72-13495*# IIT Research Inst., Chicago, Ill.
USES OF CERAMICS IN MICROELECTRONICS: A SURVEY Technology Utilization
W. R. Bratschun, A. J. Mountvala, and A. G. Pincus Washington NASA 1971 174 p refs Sponsored by NASA
(NASA-SP-5097; LC-78-611801) Avail: NTIS; SOD $1.00 Stock No. 3300-0388 CSCL 11B

The properties and behavior of ceramic materials used in components for electronic circuitry are examined to appraise the present and future directions for microelectronics, and to suggest further product development, and how innovations may be useful in other technologies. Ceramic and glass insulators, resistors, capacitors, and the use of ceramics and glasses in microcircuitry are discussed along with technology transfer to nonaerospace uses. F.O.S.

N72-13496*# United Aircraft Corp., East Hartford, Conn. Research Labs.
THE KINETICS OF CRYSTALLIZATION OF MOLTEN BINARY AND TERNARY OXIDE SYSTEMS AND THEIR APPLICATION TO THE ORIGINATION OF HIGH MODULUS GLASS FIBERS
J. F. Bacon Washington NASA Nov. 1971 310 p refs
(Contracts NASw-1301; NASw-2013)
(NASA-CR-1856; K910939-4) Avail: NTIS HC $6.00/MF $0.95 CSCL 11D

Emphasis on the consideration of glass formation on a kinetic process made it possible to think of glass compositions different from those normally employed in the manufacture of glass fibers. Approximately 450 new glass compositions were prepared and three dozen of these compositions have values for Young's modulus measured on bulk specimens greater than nineteen million pounds per square inch. Of the new glasses about a hundred could be drawn into fibers by mechanical methods at high speeds. The fiber which has a Young's modulus measured on the fiber of 18.6 million pounds per square inch and has been prepared in quantity as a monofilament (to date more than 150 million lineal feet of 0.2 to 0.4 mil fiber have been produced). This fiber has also been successfully incorporated both in epoxy and polyimide matrices. The epoxy resin composite has shown a modulus forty percent better than that achievable using the most common grade of competitive glass fiber, and twenty percent better than that obtainable with the best available grade of competitive glass fiber. Other glass fibers of even higher modulus have been developed. Author

N72-13497*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
MICROCRATERS FORMED IN GLASS BY LOW DENSITY PROJECTILES
J.-C. Mandeville (ONERA, Paris) and James F. Vedder 1971 28 p refs Submitted for publication Sponsored in part by ESRO
(NASA-TM-X-67469) Avail: NTIS CSCL 11D

Microcraters were produced in soda-lime glass by the impact of low density projectiles of polystyrene (ρ = 1.06 g/cu cm) with masses between 0.7 and 62 picograms and velocities between 2 and 14 km/s. The morphology of the craters depended on the velocity and the angle of incidence of the projectiles and these are discussed in detail. It was found that the transitions in morphology of the craters formed by polystyrene spheres occurred at higher velocities than they did for more dense projectiles. Author ESRO

N72-13498# Massachusetts Inst. of Tech., Cambridge. Dept. of Metallurgy and Materials Science.
BASIC RESEARCH IN CRYSTALLINE AND NONCRYSTALLINE CERAMIC SYSTEMS Annual Report
W. D. Kingery and R. L. Coble Apr. 1971 44 p refs
(Contract AT(30-1)-3773)
(MIT-3773-103) Avail: NTIS

The major areas of investigation of ceramic systems included: studies of kinetics of phase changes, diffusion, and the development of microstructure; relations of properties to composition, crystal structure, and microstructure; and materials synthesis and preparation. Defect structures and their mobilities in crystals and atomic transport of train boundaries were studied in several materials. The effects of thermal gradients on nonstoichiometric oxides delineated the effects of trace impurities on resulting properties. Further modelling for microstructure development in hot pressing was carried out, as were sintering studies. Strength and microstructural effects were studied briefly. Chemical vapor deposition apparatus was assembled and process variables studied for the preparation of a variety of crystals, both pure and doped. Studies of solid solutions and defect compensation in single crystals are underway. Author (NSA)

N72-13499*# Illinois Univ., Urbana. Coordinated Science Lab.
RECOMBINATION LUMINESCENCE IN IRRADIATED SILICON: EFFECTS OF THERMAL ANNEALING AND LITHIUM IMPURITY Ph.D. Thesis
Eric Shanks Johnson Mar. 1971 197 p refs
(Contracts NAS7-100; JPL-952383)
(NASA-CR-124715; AD-721522; R-502; UILU-ENG-71-2205) Avail: NTIS CSCL 11D

Silicon crystals which have been irradiated with high-energy electrons at room temperature show two strong luminescence bands in the near infrared, when observed at low temperature. Both bands have a sharp zero-phonon peak followed by a series of broad phonon-assisted peaks. The effects of isochronal annealing and lithium impurity on the luminescence bands has been determined. Author (GRA)

N72-13500# Army Missile Command, Redstone Arsenal, Ala. Ground Equipment and Materials Directorate.
CERAMIC MATERIALS RESEARCH Status Report, 1971
Phillip A. Ormsby and Furman H. Brown 21 Jun. 1971 24 p refs

(DA Proj. 1T0-26105-A-330)
(AD-728816; RL-TR-71-8; AMCMS-Code-502E.11.29600)
Avail: NTIS CSCL 11/2

The report presents the results of three efforts: (1) improvement of fused silica, (2) development of new/improved glass ceramics, and (3) ferrites for latching phasers, along with future plans for continued research. Specific materials discussed include fiber reinforcement of fused silica, the lithium-alumina silicate ternary ceramic, and lithium-substituted ferrites.
Author (GRA)

N72-13501# Pennsylvania State Univ., University Park. Materials Research Lab.
MATERIALS PREPARATION AND CHARACTERIZATION Annual Technical Progress Report, 1 Jul. 1970 - 30 Jun. 1971
Aug. 1971 178 p refs
(Contract DA-49-083-OSA-3140)
(AD-729048) Avail: NTIS CSCL 11/7

The report brings together reports on the research of faculty affiliated with the Materials Research Laboratory at the Pennsylvania State University. It includes, but is not limited to, the research supported by the Advanced Research Projects Agency. The report brings together under new headings the interrelated work conducted by faculty members with backgrounds in a variety of disciplines. In addition it singles out certain classes of materials receiving special attention as follows: Preparation of materials; Characterization of materials; Properties of materials; Noncrystalline solids including glasses; Solid state geoscience and biosciences. The report also includes a description of the extensive efforts of the laboratory under the heading of "Science and Technology Transfer," and finally appends a bibliography of papers published during the last twelve months, reprints of which are available upon request. Author (GRA)

N72-13502# Hydronautiks, Inc., Laurel, Md.
RESEARCH ON TECHNIQUES TO PREDICT THE RESISTANCE OF MATERIALS TO RAIN EROSION Final Summary Report
Andrew F. Conn and S. Lee Rudy May 1971 110 p refs
(Contract N00019-70-C-0276)
(AD-729024; TR-7011-1) Avail: NTIS CSCL 11/3

The latest phase of an experimental and analytical investigation to develop design characteristics for improved rain erosion resistant coatings is described. Dynamic fracture measurements with a split Hopkinson pressure bar facility have been correlated with AFML rocket sled tests. High speed photography has been used to observe the dynamic deformations of coating materials. The role of fatigue in rain erosion is defined, by an analysis of a wide variety of simulated rain experiments on polymethylmethacrylate. Stress wave interaction studies of coating-substrate systems have been initiated as background for development of multilayered erosion protection coatings. Author (GRA)

N72-13503# Harry Diamond Labs., Washington, D.C.
EPOXY CURING AGENTS. 2: DEACTIVATED IMIDAZOLES AND FLEXIBLE SYSTEMS
Thomas J. Dearlove Jul. 1971 35 p refs
(HDL Proj. CMT91)
(AD-729300; HDL-TR-1552; AMCMS-Code-522A.11.62400; DA Proj. 1B2-62301-A-300) Avail: NTIS CSCL 11/1

Imidazole-type compounds will cure epoxy adhesives under moderate conditions and impart a relatively high heat resistance to the product. Various means of increasing the pot life to permit extended storage prior to use were studied. These included deactivation of the imidazole ring with chloro, nitro, and cyano groups which rendered the catalyst inactive toward epoxy resins, microencapsulation of imidazoles, also unsuccessful, and use of imidazole salts which yielded a heat-resistant adhesive but required high curing temperatures. The mechanisms of imidazole curing of two flexible epoxy systems, on a polyesterurethane elastomer system, and the other a polysulfide rubber system, were studied by means of infrared and nuclear magnetic resonance spectroscopy. A novel side reaction involving the imidazole catalyst in the polysulfide rubber system is discussed.
Author (GRA)

19 MATHEMATICS

Includes calculation methods and theory; and numerical analysis. For applications see specific categories. For related information see also: 08 Computers.

N72-13504# Energiya Publishing House, Moscow (USSR).
AUTOMATIC NUMERICAL CORRELATORS
Yu. I. Gribanov, G. P. Veselova, and V. N. Andreyev 1971 241 p refs In RUSSIAN
Avail: NTIS

The calculation of correlation functions is considered. Major errors due to methods of determination, statistical, and other errors in the analysis of eccentric random processes are discussed. Various methods of correlation function determination are reviewed. Basic numerical correlator assemblies and their construction are also investigated. Transl. by K.P.D.

N72-13505*# Stanford Univ., Calif. Information Systems Lab.
EQUICONTROLLABILITY AND THE MODEL FOLLOWING PROBLEM
Richard T. Curran Jul. 1971 112 p refs
(Grant NGL-05-020-007)
(NASA-CR-124768; SU-SEL-71-034; TR-6303-2) Avail: NTIS CSCL 12A

Equicontrollability and its application to the linear time-invariant model-following problem are discussed. The problem is presented in the form of two systems, the plant and the model. The requirement is to find a controller to apply to the plant so that the resultant compensated plant behaves, in an input-output sense, the same as the model. All systems are assumed to be linear and time-invariant. The basic approach is to find suitable equicontrollable realizations of the plant and model and to utilize feedback so as to produce a controller of minimal state dimension. The concept of equicontrollability is a generalization of control kanonical (phase variable) form applied to multivariable systems. It allows one to visualize clearly the effects of feedback and to pinpoint the parameters of a multivariable system which are invariant under feedback. The basic contributions are the development of equicontrollable form; solution of the model-following problem in an entirely algorithmic way, suitable for computer programming; and resolution of questions on system decoupling. Author

N72-13506# Academy of Sciences of the Ukranian SSR, Kiev (USSR).
DATA ANALYSIS USING AUTOMATED CONTROL SYSTEMS
V. M. Glushkov 1970 183 p refs In RUSSIAN
Avail: NTIS

The storage and operating aspects of automatic control systems are discussed. A review and comparative analysis of principles and methods is given. Methods of duplication, correction, search, and internal and external sorting are also considered.
Transl. by K.P.D.

N72-13507# Academy of Sciences (USSR), Moscow.
ON A NUMERICAL METHOD FOR SOLVING THE PROBLEMS OF OPTIMAL CONTROL WITH DELAYS
L. I Shatrovsky 1970 21 p refs In RUSSIAN and FRENCH
(D-35) Avail: NTIS

In control processes, differential equations with a delayed argument reflect the fact that the systems measured yield information on the state of the process with a particular delay.

Their measurement may be considered the average of measured quantities during certain time intervals. The equations of state for a control process are given. Equations are derived for a regularly continuing process of minimization of the terminal functional.
Transl. by K.P.D.

N72-13508*# Texas Univ., Austin. Electronics Research Center.
THE STABILITY OF COUPLED RENEWAL-DIFFERENTIAL EQUATIONS WITH ECONOMETRIC APPLICATIONS
Ronald P. Rhoten and J. K. Aggarwal 15 Jul. 1969 56 p refs
(Contract NAS8-18120; Grants AF-AFOSR-0766-67; NSF GK-1879; AF Proj. 4751)
(NASA-CR-124712; Rept-6144501f; Rept-681305; JSEP-TR-69; AFOSR-69-2133TR) Avail: NTIS CSCL 12A

Concepts and results are presented in the fields of mathematical modeling, economics, and stability analysis. A coupled renewal-differential equation structure is presented as a modeling form for systems possessing hereditary characteristics, and this structure is applied to a model of the Austrian theory of business cycles. For realistic conditions, the system is shown to have an infinite number of poles, and conditions are presented which are both necessary and sufficient for all poles to lie strictly in the left half plane. Author

N72-13509# Eidgenossische Technische Hochschule, Zurich (Switzerland).
STUDIES FOR THEORETICAL NOMOGRAPHY Ph.D. Thesis [UNTERSUCHUNGEN ZUR THEORETISCHEN NOMOGRAPHIE]
Roland Wyss 1971 80 p refs In GERMAN
(Diss-4587) Avail: NTIS

Mathematical connections of nomography with projective and algebraic geometries, function theory, topology, and differential geometry are considered. Nomographic processes are analyzed and the various nomographic methods ordered with emphasis on net geometries. A projective classification of parallelizable 3-nets is given as well as nonprojective representations which transform three single parametric line bundles into straight lines. The nucleus of theoretical nomography is the unproved assumption that a stretchable, but non-parallelizable 3-net is definitely extendable. This theorem is used to define the extension conditions in a general coordinate system and to formulate a new criterium for parallelizable nets. Transl. by G.G.

N72-13510# Eidgenossische Technische Hochschule, Zurich (Switzerland).
SPACE GROUPS IN n DIMENSIONS AND COHOMOLOGY Ph.D. Thesis [RAUMGRUPPEN IN n DIMENSIONEN UND COHOMOLOGIE]
Evelyn Schorta-Schrag 1971 42 p refs In GERMAN
(Diss-4419) Avail: NTIS

Considered is a subgroup G in the Euclidean group of the n-dimensional real space R sup n that forms a free Abel group U of n value through commutation of R sup n so that a complete commutational group of R sup n is obtained. Algebraic cohomological methods are used to transfer affinitive space groups into n dimensions and it is shown that the solution depends on the disappearance of certain cohomology groups.
Transl. by G.G.

N72-13511# Sheffield Univ. (England). Dept. of Probability and Statistics.
A COMBINATORIAL PROOF OF THE DISTRIBUTION OF THE TIME TO FIRST EMPTINESS OF A DAM WITH MARKOVIAN INPUTS
J. P. Matthews Jan. 1971 7 p refs
(RR-73/JPM2) Avail: NTIS

The combinatorial lemma of Mott for a dam with independent inputs is extended to obtain the distribution of the time to first emptiness of an infinite dam with Markov dependent integral inputs subject to steady unit demand. A new expression for this distribution is obtained in terms of the trace of the matrix probability generating function of the inputs. The result is shown to agree with the expressions given by others in terms of the principal eigenvalue of this matrix. Author

N72-13512# Sheffield Univ. (England). Dept. of Probability and Statistics.
SOME CHARACTERIZATIONS FOR THE POISSON DISTRIBUTION STARTING WITH A POWER-SERIES DISTRIBUTION
D. N. Shanbhag and R. M. Clark Mar. 1971 9 p refs
(RR-74/DNS-RMC-1) Avail: NTIS

The characterizations are based on the assumption that X has a power series distribution with parameter theta such that: P sub x = ((a sub x)(theta to the xth))/A(theta), where (x = 0, 1,...). A variant of the Rao-Rubin result, an a priori distribution of the parameter theta, and Lehmann's unbiased estimator of P sub 0 are considered. N.E.N.

N72-13513# Sheffield Univ. (England).
SOME APPROXIMATIONS TO THE EXTENTED HYPERGEOMETRIC DISTRIBUTION
R. M. Clark May 1971 13 p refs
(RR-80/RMC2) Avail: NTIS

One form of the extended hypergeometric distribution arises naturally in Fisher's exact significance test for the odds-ratio in a 2 x 2 table. Gart (1962) developed an approximation to this distribution, using a binomial approximation given by Wise (1954). It is demonstrated that Gart's criterion for the goodness of his approximation is inadequate. A new approximation is then developed, by fitting an appropriate density function to the discrete probability distribution. This method appears to give better approximations than Gart's procedure, although more computational effort is required. Author

N72-13514# Sheffield Univ. (England). Dept. of Probability and Statistics.
ASYMPTOTIC DISTRIBUTION OF THE SERIAL CORRELATION COEFFICIENT AND SOME RELATED CHARACTERIZATIONS OF GAMMA AND EXPONENTIAL DISTRIBUTIONS
D. N. Shanbhag and I. V. Basawa Apr. 1971 10 p refs
(RR-75/DNS-IVB1) Avail: NTIS

For an exponential distribution, the criterion (S sub 1) -1 has the same asymptotic distribution as the usual serial correlation coefficient r. E(S sub 1) is equal to n/(n+1). It is shown that if the underlying distribution is a member of the exponential family, then these properties characterize the exponential distribution. An attempt is made to link the general characterization problems with those under the restriction that the distribution belongs to the exponential family. An extension for Doob's central limit theory is also given. Author

N72-13515# Sheffield Univ. (England). Dept. of Probability and Statistics.
MAXIMUM LIKELIHOOD ESTIMATION OF PARAMETERS IN RENEWAL MODELS
I. V. Basawa Apr. 1971 7 p ref
(RR-76/IVB5) Avail: NTIS

A suitable realization of the Poisson count process is used to determine the likelihood function for estimating the parameters of a renewal process. It is noted that the method requires only the knowledge of the Laplace transform of the probability density of between-event intervals. Author

N72-13516# Sheffield Univ. (England). Dept. of Probability and Statistics.
EXPANSIONS FOR THE NON-CENTRALITY PARAMETER OF CHI-SQUARE IN CONTINGENCY TABLES
R. M. Clark May 1971 13 p refs
(RR-81/RMC-3) Avail: NTIS

An expansion is given in terms of canonical correlations for the noncentrality parameter of the asymptotic distribution of the chi-square statistic from an r times c contingency table generated by a sample from any phi square-bounded bivariate distribution, thereby generalizing the results of Lancaster and Hamdan (1964). For the particular case when the underlying distribution in bivariate normal with correlation coefficient rho, conditions are given under which the procedure for estimating rho given by Lancaster and Hamdan reduces to Pearson's method using root mean square contingency. Author

N72-13517*# Illinois Univ., Urbana. Lab. for Ergonomics Research.
A LINEAR COMBINATION OF MODIFIED BESSEL FUNCTIONS
A. Shitzer and J. C. Chato Nov. 1971 27 p refs
(Grant NGR-14-005-103)
(NASA-CR-124738; ME-TN-310) Avail: NTIS CSCL 12A

A linear combination of modified Bessel functions is defined, discussed briefly, and tabulated. This combination was found to recur in the analysis of various heat transfer problems and in the analysis of the thermal behavior of living tissue when modeled by cylindrical shells. Author

N72-13518*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
APPLICATION OF MONTE CARLO TECHNIQUES TO OPTIMIZATION OF HIGH-ENERGY BEAM TRANSPORT IN A STOCHASTIC ENVIRONMENT
Russell V. Parrish, James E. Dieudonne, and Tassos A. Filippas Washington Dec. 1971 47 p refs
(NASA-TN-D-6571; L-7930) Avail: NTIS CSCL 12A

An algorithm employing a modified sequential random perturbation, or creeping random search, was applied to the problem of optimizing the parameters of a high-energy beam transport system. The stochastic solution of the mathematical model for first-order magnetic-field expansion allows the inclusion bf state-variable constraints, and the inclusion of parameter constraints allowed by the method of algorithm application eliminates the possibility of infeasible solutions. The mathematical model and the algorithm were programmed for a real-time simulation facility; thus, two important features are provided to the beam designer: (1) a strong degree of man-machine communication (even to the extent of bypassing the algorithm and applying analog-matching techniques), and (2) extensive graphics for displaying information concerning both algorithm operation and transport-system behavior. Chromatic aberration was also included in the mathematical model and in the optimization process. Results presented show this method as yielding better solutions (in terms of resolutions) to the particular problem than those of a standard analog program as well as demonstrating flexibility, in terms of elements, constraints, and chromatic aberration, allowed by user interaction with both the algorithm and the stochastic model. Example of slit usage and a limited comparison of predicted results and actual results obtained with a 600 MeV cyclotron are given. Author

N72-13519*# Texas Univ., Dallas.
ON THE METHOD OF ERMAKOV AND ZOLOTUKHIN FOR MULTIPLE INTEGRATION
R. Cranley (Liverpool Univ.) and T. N. L. Patterson (Queens Univ., Belfast) [1971] 17 p refs
(Grant NGL-44-004-001)
(NASA-CR-124827; SP-71-021) Avail: NTIS CSCL 12A

The method of Ermakov and Zolotukhin is discussed along with its later developments. By introducing the idea of pseudo-implementation a practical assessment of the method is made. The performance of the method is found to be unimpressive in comparison with a recent regression method. Author

N72-13520# McDonnell-Douglas Co., St. Louis, Mo. Research Labs.
A SELF-ADJUSTING GRID FOR FINITE-DIFFERENCE PROGRAMS
F. X. Hurley and R. K. Linback Nov. 1971 12 p refs
(MDC-Q0455) Avail: NTIS

A rather general method for efficient finite-difference grid distribution is described. The computer program automatically monitors the current gradients throughout the computational field and makes the appropriate adjustments in the local grid spacing. There are no preferential directions, and the technique is applicable to unsteady problems and to steady problems which are the asymptotic solutions of time-dependent equations. To demonstrate the method, application is made to a simple problem of unsteady, two-dimensional heat conduction. It is found that machine time is reduced by a factor of six. Author

N72-13521# Pittsburgh Univ., Pa. Dept. of Physics.
NORMAL PRODUCT QUANTIZATION OF CURRENTS IN LAGRANGIAN FIELD THEORY
J. H. Lowenstein May 1971 32 p refs
(Contract AT(30-1)-3829)
(NYO-3829-67) Avail: NTIS

Techniques for quantizing currents in Lagrangian field theory are developed with the aid of Zimmermann's normal products. These methods greatly simplify the derivation of single-current generalized Ward identities and may be used to justify the heuristic use of formal arguments in discussing broken symmetries. Applications to the energy-momentum tensor in the A4 model and to the current of broken orthogonal symmetry in a two-component scalar model are presented. Author (NSA)

N72-13522# Johann-Wolfgang-Goethe-Universitat, Frankfurt am Main (West Germany). Inst. fuer Angewandte Physik.
NEW MONTE CARLO TECHNIQUE FOR RADIATION TRANSPORT PROBLEMS: CALCULATION OF THE COMBINED SPATIAL, ANGULAR, AND ENERGY DISTRIBUTION OF MULTIPLY SCATTERED GAMMA RAYS
H. Stehfest Mar. 1971 111 p refs In GERMAN; ENGLISH summary
(BMBW-FBK-71-2) Avail: AEC Depository Libraries

The fundamental idea of the Monte Carlo technique in the application presented is that, in computing the radiation field at distance r sub 0 from the source, only those quanta are considered which have already traveled a path of length t sub 0 0 = r sub 0. Position and direction of the quanta after the path length t sub 0 are determined by a calculation in which the quanta are traced back from t sub 0 to the source. The technique is efficient enough to permit the calculation of the angular energy distribution of gamma radiation at penetration depths up to 20 mfp. Some results of the calculations are presented. Author (NSA)

N72-13523# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of High Energy.
INVARIANCE OF THE SCHROEDINGER EQUATION RELATIVE TO THE GALILEAN TRANSFORMATION
V. N. Streltsov 1971 15 p refs In RUSSIAN
(JINR-P2-5823) Avail: AEC Depository Libraries

It is shown that the Schrodinger equation is invariant relative to the Galilean transformations. It is also shown that, on the basis of the transformation formulae for the energy and the momentum of a plane wave and on the condition that there exists a limiting transition from quantum to classical mechanics, the statement of the problem on the Schrodinger equation invariance relative to spacelike transformations is correct. In this case it should be noted that the equation corresponds to the so-called properly nonrelativistic approximation; in the Galilean approximation it has a trivial form. As for the nonrelativistic invariance requirement, not the Schrodinger equation but another nonlinear equation different from Schrodinger's by the form of the time term satisfies it. Some difficulties of quantum mechanics should be taken into account. The elimination of these difficulties

may apparently be connected only with the rejection from Ehrenfest's theorem. In particular, it is shown that the transformed wave function of the plane wave does not assume additional phase in the nonrelativistic approximation. Author (NSA)

N72-13524# Rome Univ. (Italy). Inst. of Physics.
ON A DIFFERENTIAL EQUATION APPROACH TO QUANTUM FIELD THEORY: CAUSALITY PROPERTY FOR THE SOLUTIONS OF THIRRING'S MODEL
P. DeMottoni (CNR, Rome) and E. Salusti 31 Mar. 1971 16 p refs
(Nota-Interna-309) Avail: NTIS

A causality property is established for the solutions of Thirring's model, where the fields are operator valued functions of the space-time variables. This property is just what one expects for the convolution of a Wightman field with a compactly supported C sup infinity function. Author (ESRO)

N72-13525# Purdue Univ., Lafayette, Ind. School of Electrical Engineering.
LINEAR SYSTEMS
Clayton Paul Griffiss AFB, N. Y. RADC Jul. 1971 155 p refs (Contract F30602-70-C-0185)
(AD-728631; RADC-TR-71-134) Avail: NTIS CSCL 12/1

The report documents a series of seminars at Rome Air Development Center with the content equivalent to an intense course in Linear Systems. Material is slanted toward the practicing engineer and introduces some of the fundamental concepts and techniques for analyzing linear systems. Techniques for representing nonlinear systems in linear terminology are explored as modern systems theory is introduced in a simplified form. Author (GRA)

N72-13526# Naval Ammunition Depot, Crane, Ind. Quality Evaluation and Engineering Lab.
A COMPARISON OF METHODS OF ANALYZING ATTRIBUTE DATA UTILIZING COMPUTER SIMULATION
Donald L. Jerger Jul. 1971 38 p refs
(AD-728752; QETR-11) Avail: NTIS CSCL 12/1

The report describes a simulation study used to evaluate the performance of four methods of analyzing attribute (go-no go) data in a two-factor classification. Sets of proportions were developed within the limitations of seven influencing factors and each set was subjected to analysis by each method. Using the percentage points (alpha's) of the F-distribution which coincide with the tests of significance, the methods were evaluated in light of the influencing factors. It was concluded that the arcsine transformation of proportions method is preferable for all around use. The zero-one (0 - 1) method has application where the mean proportion defective (P bar) is approximately in the range 0.2 to 0.8. Author (GRA)

N72-13527# Atmospheric Sciences Lab., White Sands Missile Range, N.Mex.
A METHOD FOR EVALUATING MODEL PARAMETERS BY NUMERICAL INVERSION
Gary A. Ethridge Apr. 1971 33 p refs
(AD-728810; ECOM-5374) Avail: NTIS CSCL 12/1

A technique for the determination of parameter values in the equations modeling a physical system is described which uses a variation of the differential corrections curve-fitting technique and field data. Analytic closed-form solutions are not required, and a digital computer program exists for the mathematical solution to the equations of the model. Specific examples in atmospheric diffusion and a missile ballistic model show how to recover diffusion parameters and aerodynamic coefficients using field data and the computer numerical solution to the mathematical model. Author (GRA)

N72-13528# Princeton Univ., N.J. Dept. of Mathematics.
HARMONIC ANALYSIS, DIFFERENTIAL EQUATIONS, CALCULUS OF VARIATIONS WITH APPLICATION TO STABILITY OF COMPLEX GEOMETRIC STRUCTURES Final Report, 1 Jul. 1968 - 30 Jun. 1971
E. M. Stein Jul. 1971 5 p
(Grant AF-AFOSR-1467-68; AF Proj. 9749)
(AD-728718; AFOSR-71-2249TR) Avail: NTIS CSCL 12/1

The report summarizes the research results obtained under the referenced Grant during the period 1 July 68 through 30 June 71, lists the manuscripts and reprints which report these results, and lists the individuals (partially) supported under the Grant. Briefly stated, these results concern the convergence of Poisson integrals, the analogues of singular integral operators and certain pseudo-differential operators, the Littlewood-Paley theory, Markov chains, the Neumann problem, the boundary behavior of positive harmonic functions, integral transforms and singular integrals. Author (GRA)

N72-13529# Texas Univ., Austin. Dept. of Mathematics.
RESEARCH IN APPROXIMATION THEORY WITH APPLICATIONS TO SIMULATIONS OF COMPLEX SYSTEMS Final Technical Report
E. W. Cheney 12 Aug. 1971 7 p refs
(Grants AF-AFOSR-1109-67; AF-AFOSR-1109-69; AF Proj. 9749)
(AD-728681; AFOSR-71-2270TR) Avail: NTIS CSCL 12/1

The report summarizes the scientific activity under the subject grant by presenting abstracts of the manuscripts produced therein. The titles discussed include the following: On the existence of extremal projections; Minimal projections on hyperplanes in sequence spaces; Minimal projections with prescribed carriers; Existence subspaces in approximation theory; On the construction of a class of smoothing splines in several variables; On the construction of a class of generalized interpolating splines in one variable; A generalization of the construction method of Laurent and Carasso for interpolating L-splines; Generalized smoothing spline functions for operators; Multidimensional spline approximation methods. GRA

N72-13530# University of Southern Calif., Los Angeles. Dept. of Aerospace Engineers.
NONLINEAR CONTROLLABILITY
Alexander Liang Aug. 1971 22 p refs
(Grant AF-AFOSR-1244-67; AF Proj. 9749)
(AD-728671; AFOSR-71-2303TR; Rept-61102F; Rept-681-304) Avail: NTIS CSCL 12/1

Necessary and sufficient conditions for complete controllability of a general class of nonlinear control systems of the form $x' = f(x) + G(x)u$ are derived. The derivation of these conditions makes use of properties of certain Pfaffian equations associated with the control system and properties of the Penrose pseudo-inverse of matrices. Author (GRA)

N72-13531# Institute for Advanced Study, Princeton, N.J.
MATHEMATICAL ANALYSIS Final Status Report
Atle Selberg 28 Jun. 1971 11 p
(Grant AF-AFOSR-1712-69; AF Proj. 9749)
(AD-728694; AFOSR-71-2248TR; Rept-61102; Rept-681304) Avail: NTIS CSCL 12/1

Two special research programs were conducted under this Grant; the first, during the academic year 1969-70, in mathematical analysis, the second, during the academic year 1970-71, in number theory. The former included research in mean-periodicity in several variables, topics in the theory of lifting, the mathematical structure of quantum theory, the perturbation theory of linear operators, and harmonic analysis on Lie groups. The latter included research in problems of transcendentality and approximation, density-type results about the distribution of zeros of zeta- and L-functions, class number problems, and problems of the distribution of general multiplicative and additive functions. Author (GRA)

N72-13532# Carnegie-Mellon Univ., Pittsburgh, Pa. Dept. of Mathematics.
FREE BOUNDARY PROBLEMS FOR PARABOLIC

EQUATIONS Final Report, 1 May 1965 - 31 Dec. 1969
Ignace I. Kolodner 25 Aug. 1971 7 p refs
(Contract Nonr-760(27); NR Proj. 041-315)
(AD-729052) Avail: NTIS CSCL 12/1

A Free boundary problem is a boundary value problem for a (partial) differential equation in a domain which is not fully known but must be also determined. This project is concerned with such problems when the PDE involved is of parabolic type. Problems of this type occur in practice in the study of change of phase (e.g., evaporation, condensation, freezing, melting, sublimination), and are frequently called (generalized) Stefan problems. The specific objective was to study some special problems by reduction to equivalent integral equations, and to write a monograph on the subject. Author (GRA)

N72-13795*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THE EFFECTS OF RANDOM ACCELERATIONS ON ESTIMATION ACCURACY WITH APPLICATIONS TO THE MARINER 1969 RELATIVITY EXPERIMENT
D. W. Curkendall, S. G. Finley, M. W. Nead, V. J. Ondrasik, and C. L. Thornton *In its* Proc. of the Conf. on Exptl. Tests of Gravitation Theories 1 Nov. 1971 p 148-157 refs (See N72-13776 04-30)
Avail: NTIS CSCL 12A

20 METEOROLOGY

Includes climatology; weather forecasting; and visibility studies. For related information see also: 13 Geophysics; and 30 Space Sciences.

N72-13533 National Lending Library for Science and Technology, Boston Spa (England).
ON THE LONG-TERM VARIATIONS IN THE OCEAN-ATMOSPHERE SYSTEM
M. A. Valerianova and E. I. Serjakov [1971] 9 p refs Transl. into ENGLISH from Akad. Nauk., Okeanograf. Kom., Okeanologija (Moscow), v. 10, 1970 p 750-756
(NLL-M-20932-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

Long-term variations of thermal conditions in the ocean and their interaction with atmospheric circulation were studied in the North Atlantic. Charts of monthly mean sea level pressure for the last 70 years, and water temperature observations at coastal stations, and weather ships were used as data for the analysis. The annual amount of heat lost in evaporation and heat exchange with the atmosphere, and distribution of the heat balance at the surface are discussed. The analysis of heat balance anomalies, warm advection by currents and surface water anomalies show that changes in the thermal state of the ocean are due to warm advection by currents. Changes in water temperature can be predicted and with an analysis of pressure fields, the type of field likely to appear can be determined. F.O.S.

N72-13534 National Lending Library for Science and Technology, Boston Spa (England).
ON PERIODS FOR THE CALCULATION OF MONTHLY MEAN AIR TEMPERATURE AVERAGES
L. B. Klebaner [1971] 4 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), no. 258 p 114-118
(NLL-M-20763-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

The period of time required for observations of temperatures to be significant in determining average temperatures is discussed. Advantages and disadvantages of short time observations are analyzed. It is concluded that the length of time required to produce adequate information on which to calculate average tenperatures is dependent upon the range of fluctuations occurring in the particular geographic area. Author

N72-13535 National Lending Library for Science and Technology, Boston Spa (England).
SOME RESULTS OF A STUDY OF THE STATISTICAL TIME STRUCTURE OF TEMPERATURE
L. L. Braginskaja [1971] 7 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), no. 267, 1970 p 100-106
(NLL-M-20931-(5828.4F)) Avail.: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

The dependence of an element's correlation function on meteorological conditions was investigated. Recordings of temperature fluctuations were made using a thermoanemometer. Gradient observations were made at the same time as the structure observations, at heights of 0.5 and 1.5 m or 0.65 and 2 m. A parameter of atmospheric stratification epsilon, was calculated from the gradient data. Recordings were made for 5 to 10 minutes at a height of 2m, and 22 series of temperature fluctuations recordings were analyzed. Correlation functions of temperature were calculated for different values of the stability parameter epsilon. The error in the determination of mean temperature increases as instability increases, irrespective of the time constant of the measuring instrument. It was determined that advance estimates of errors in mean temperature calculation can be made from the instantaneous readings of an inertial instrument. These errors depend on season and time of day. K.P.D.

N72-13536 National Lending Library for Science and Technology, Boston Spa (England).
CHARGE RELAXATION ON AN ELECTROPHOTOGRAPHIC SURFACE IN INTERACTION WITH LIQUID ATMOSPHERIC AEROSOLS
L. G. Juskeselieva and Antonov. A. S. 16 Feb. 1971 3 p refs Transl. into ENGLISH from Compt. Rend. Acad. Bulgare Sci. (Sofia), v. 21, no. 5, 1968 p 431-433
(NLL-M-20321-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

The electrophotographic method of recording atmospheric particles is described. A latent electrostatic image is obtained on a high resistance semiconductor with stable electrification, and then the image is developed. It was found that the charge of the semiconductor surface is rapidly removed as a result of the direct collision with water droplets. The equations for determining the recombination coefficient are derived. It is concluded that each collision of water droplet with the charged semiconductor surface leads to relaxation, irrespective of whether or not there is imqurity in the water. An electrophotographic image of water droplets was obtained, and coarsely dispersed liquid aerosols were measured in the atmosphere. F.O.S.

N72-13537 National Lending Library for Science and Technology, Boston Spa (England).
METHODS OF PHYSICO-STATISTICAL FORECASTING OF TEN-DAY MEAN TEMPERATURE
G. I. Morskoj and Azim. S. M. [1971] 4 p ref Transl. into ENGLISH from Glav. Uprav. Gidromet. Sluzh., Met. Gidr. (Leningrad), no. 7, 1970 p 84-86
(NLL-M-20846-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

The development of a technique for predicting ten-day mean temperatures based on physico-statistical anlaysis of meteorological parameters is discussed. Temperature, cloudiness, and 500 millibar height fields covering the earth's northern hemisphere are needed to make forecasts by the method described. Various mathematical applications and models are presented to explain the process. Author

N72-13538 National Lending Library for Science and Technology, Boston Spa (England).
INTERRELATION BETWEEN TEMPERATURE AND RELATIVE HUMIDITY IN DIFFERENT CLOUD AND WIND SPEED CONDITIONS
V. F. Hodakova [1971] 5 p refs Transl. into ENGLISH from

Tr. Gl. Geofiz. Observ. (Leningrad), no. 266, 1970 p 96-102
(NLL-M-20799-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

Meteorological data from three observational points are evaluated to establish interrelations between relative humidity and air temperatures. Most frequently met combinations serve as criteria for defining the basic content of climatic action. Results show that clear skies reduce relative humidity less in the morning, evening and night in autumn and winter, but have a marked effect in spring and summer, and all year round in the afternoon. At 1300 hours in October the probability of a 80 to 100% relative humidity is only about 7% when the sky is cloudy, whereas the probability of a 40 to 60% relative humidity is 50% when the sky is clear. Data for 1300 hours in April and July show the decisive effect of cloudiness on air humidity. G.G.

N72-13539 National Lending Library for Science and Technology, Boston Spa (England).
A MODEL OF NUMERICAL PRECIPITATION FORECASTING FOR FIVE DAYS IN ADVANCE
A. L. Kac, Sh. A. Musaeljan, M. N. Fedulova, and N. N. Apprauseva [1971] 12 p refs Transl. into ENGLISH from Glav. Uprav. Gidromet. Sluz., Met. Gidr. (Leningrad), no. 10, 1970 p 11-22
(NLL-M-20924-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

A way of forecasting the total amount of precipitation in 5 days in the agricultural regions of the USSR using hydrodynamical forecasts of the 500 mb height for 24, 48 and 72 hours in advance is described. The basic hypothesis is that large-scale circulation features are related to the precipitation distribution. The problem is solved by the multiple regression method, with constant recalculation of empirical influence functions in the forecasting part of the scheme. Author

N72-13540 National Lending Library for Science and Technology, Boston Spa (England).
A GEOSTROPHIC WIND DURING CYCLOGENESIS
V. D. Reshetov [1971] 9 p refs Transl. into ENGLISH from Tr. Tsentr. Aerolog. Observ. (Moscow), no. 93 p 96-105
(NLL-M-20894-(5828-4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

Geostrophic motion was studied in the main types of circulation in the atmosphere including depressions and anticyclones. Data for winter and summer were considered separately. Gradient winds were determined allowing for the curvature of the contours for the main isobaric surfaces. The statistical analysis shows: that geostrophic motion in summer depressions is similar to that in winter, that cyclogenesis processes occur in the troposphere and stratosphere, and that geostrophic motions in different layers of the atmosphere are interrelated. F.O.S.

N72-13541 National Lending Library for Science and Technology, Boston Spa (England).
AIR POLLUTION'S RELATION TO METEOROLOGY
D. Szepesi [1971] 19 p refs Transl. into ENGLISH from Energia Atomtech. (Budapest), v. 23, 1970 p 215-222
(NLL-M-20929-(5828.4F)) Avail.: Natl. Lending Library, Boston Spa, Engl.: 2 NLL photocopy coupons

The role meteorology in the reduction of air pollution is considered. Meteorological factors which contribute to air pollution are discussed, as well as how pollution, meteorological factors, and permissible concentrations are related. Finally, the forecasting of air pollution and the results of smog studies are reviewed. Author

N72-13542# Swiss Inst. of Meteorology, Zurich.
THE THUNDERSTORM CONDITIONS IN THE SOUTHERN CENTRAL ALPS AND IN THE BEGINNING ALPS [DIE GEWITTERVERHAELTNISSE IN DEN SUEDLICHEN ZENTRALALPEN UND VORALPEN]
E. Zenone (Osservatorio Ticinese) 1971 22 p refs In GERMAN; ENGLISH summary
(Rept-22) Avail: NTIS

An analysis of thunderstorm activity in the European Alps for a period of seventeen years is presented. Relationships between wind direction and thunderstorm occurrence were investigated and the feasibility of a statistical analysis was examined. The thunderstorms were divided into three different groups and the different properties of each type were analyzed to determine the expected severity and duration. P.N.F.

N72-13543# Swiss Inst. of Meteorology, Zurich.
THE STATISTICAL EVALUATION OF LONG-RANGE TEMPERATURE SERIES
Theo Ginsburg 1970 46 p refs In GERMAN; ENGLISH summary
(MZA-19; UDC-551.501.45:551.524.3) Avail: NTIS

An attempt is made to develop methods by which an extensive collection of data representing the daily values of temperature at a station, over a period of several decades, can be compressed into as compact a form as possible without significant loss of climatological information. A mathematical model of the temperature series must be found which can reproduce the measured values with good accuracy but which requires only a few characteristic numbers. The Markov model of a random process is examined as a suitable model. Two assumptions required for this model are proved, using the temperature series at Basel for the period 1901 to 1963. This satisfactory reproduction of the annual temperature structure leads to the possibility of representing a long series of climatological data in the most economical manner by means of the Fourier coefficients of the mean temperature T, the standard deviations and the coefficient of peristence a. The number of terms required are 2 for T, 3 for s and 3 for a. Using this form, any temperature series can be represented with only 19 characteristic values, and condensed to 114 numbers. Author

N72-13544*# Wisconsin Univ., Madison. Space Science and Engineering Center
METEOROLOGICAL MEASUREMENTS FROM SATELLITE PLATFORMS Annual Scientific Report, 1969 - 1970
Verner E. Suomi and Thomas H. VonderHaar Aug. 1971 186 p refs
(Contract NAS5-11542)
(NASA-CR-122303) Avail: NTIS CSCL 04B

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11. THE RADIATION BALANCE OF THE EARTH ATMOSPHERE SYSTEM DURING JUNE AND JULY 1969 FROM NIMBUS 3 RADIATION MEASUREMENTS: SOME PRELIMARY RESULTS T. H. VonderHaar, E. Raschke (Ruhr Univ.), W. R. Bandeen (NASA. Goddard Space Flight Center), and M. Pasternak (NASA. Goodard Space Flight Center) p 166-174 refs (See N72-13555 04-20)

12. APPLICATION OF SIMULTANEOUS INFRARED RADIATION MEASUREMENTS AND CLOUD PHOTOGRAPHS FROM SATELLITES T. H. VonderHaar p 175-180 refs (See N72-13556 04-14)

N72-13545*# Wisconsin Univ., Madison.
RECENT DEVELOPMENTS IN SATELLITE TECHNIQUES FOR OBSERVING AND SENSING THE ATMOSPHERE
Verner E. Suomi *In its* Meteorol. Meas. from Satellite Platforms Aug. 1971 p 1-27 refs (See N72-13544 04-20)
Avail: NTIS CSCL 04B

Data covering some of the developments which hold promise for greater utilization of low altitude orbiting and geostationary satellite platforms are given. Satellite techniques for observing and sensing the atmosphere are also cited. E.H.W.

N72-13546*# Wisconsin Univ., Madison.
POSSIBILITIES FOR SOUNDING THE ATMOSPHERE FROM A GEOSYNCHRONOUS SPACECRAFT
Verner E. Suomi, Thomas H. VonderHaar, R. Krauss, and A. Stamm *In its* Meteorol. Meas. from Satellite Platforms Aug. 1971 p 28-37 refs Presented at the Symp. on Remote Sounding of the Atmosphere, 13th meeting of COSPAR, Leningrad, 20-29 May 1970 (See N72-13544 04-20)
Avail: NTIS CSCL 04B

It is demonstrated that vertical temperature sounding of the atmosphere from geostationary altitude is feasible. The meteorological and instrumental options which must be considered to obtain soundings from this great distance with the required accuracy in a reasonable period of time is treated. Measurements from the geosynchronous ATS satellites are used to examine cloud conditions. Observations from experiments on NIMBUS-3 are used to specify radiance levels to be measured. For a spin-scan system, like that planned for the SMS, an instantaneous field-of-view of 0.3 mrad - 0.4 mrad (11 km - 14 km) is recommended for the tropospheric sounding channels of 20 1/cm bandwidth near the 15 micrometer region. Results indicate that it will be possible to sound the atmosphere to the earth's surface through openings of a 95% cloud cover in less than one hour. Author

N72-13547*# Wisconsin Univ., Madison.
A RADIO ALTIMETER FOR BALLOONS AND SOME METEOROLOGICAL APPLICATIONS
Nadav Levanon and Verner E. Suomi *In its* Meteorol. Meas. from Satellite Platforms Aug. 1971 p 38-53 refs (See N72-13544 04-20)
Avail: NTIS CSCL 04B

A meteorological tool which measures the geometric altitude of meteorological balloons is presented. The results from flight tests using the tool, a low power radio altimeter, are given along with operational principles and some meteorological applications. Author

N72-13548*# Wisconsin Univ., Madison.
ACCURATE PULSE RADAR ALTIMETER FOR METEOROLOGICAL BALLOONS c14
Nadav Levanon and Ferrel Stremler *In its* Meteorol. Meas. from Satellite Platforms Aug. 1971 p 54-57 refs (See N72-13544 04-20)
Avail: NTIS CSCL 14B

A simple, light weight pulse radar altimeter package was designed and tested to accurately measure altitudes of meteorological balloons. This altimeter uses a superregenerative RF stage which is controlled by an adaptive feedback system. Altitudes to 20 km were measured accurately over Lake Michigan using a peak power of one watt. Author

N72-13549*# Wisconsin Univ., Madison.
IMAGE CORRELATOR FOR CLOUD DISPLACEMENT MEASUREMENT c14
J. G. Miller *In its* Meteorol. Meas. from Satellite Platforms Aug. 1971 p 58-68 ref (See N72-13544 04-20)
Avail: NTIS CSCL 14B

An image correlator designed for accurate wind velocity measurements from cloud displacement is described. The correlator solves the problem of navigation and distortion errors made by analog methods and provides a means for accurately determining cloud displacement from time intervals between pictures. E.H.W.

N72-13550*# Wisconsin Univ., Madison.
VORTICITY AND DIVERGENCE COMPUTATIONS FROM CLOUD DISPLACEMENTS
Thomas H. VonderHaar and Eric Smith *In its* Meteorol. Meas. from Satellite Platforms Aug. 1971 p 69-74 (See N72-13544 04-20)
Avail: NTIS CSCL 04B

A technique used to derive vorticity and divergence parameters from cloud displacements as measured by satellites is described. Definitions of both parameters are given. Results compare favorably with conventional methods. E.H.W.

N72-13551*# Wisconsin Univ., Madison.
TIME VARIATION OF TROPICAL ENERGETICS AS VIEWED FROM A GEOSTATIONARY ALTITUDE
D. N. Sikdar and Verner E. Suomi *In its* Meteorol. Meas. from Satellite Platforms Aug. 1971 p 75-93 refs (See N72-13544 04-20)
Avail: NTIS CSCL 04B

Time lapse ATS 1 satellite cloud photographs were used to evaluate the convective transport of latent heat from the lower troposphere to the tropical upper troposphere. The analysis reveals that the meso- to sub-synoptic-scale convection systems over the tropical mid-Pacific are well organized on a time scale of a few days and are controlled by the large scale motion field. The time variation of this heat transport, in the sector 120W-180W, 15N-15S, indicates an approximate periodicity of five days. Furthermore, this pulsating feature seems to be tied to a wave like disturbance field of wavelength nearly 75 deg of longitude and moving westward with an approximate speed of 15 deg of longitude per day. Author

N72-13552*# Wisconsin Univ., Madison.
ON THE POSSIBILITY OF PREDICTING THE DEVELOPMENT OF CLOUD CLUSTERS FROM THE LARGE SCALE WIND FIELD USING GEOSTATIONARY SATELLITE PICTURES
A. Frederick Hasler *In its* Meteorol. Meas. from Satellite Platforms Aug. 1971 p 94-141 refs (See N72-13544 04-20)
Avail: NTIS CSCL 04B

A practical technique for making quantitative measurements of cloud displacement from ATS 1 pictures was explained. Two ATS 1 pictures were superimposed by two projectors on an electronic digitizing table. Distortion correction, superimposition,

and rectification were done analytically through a computer program. An estimate of the accuracy of the best results to date gave cloud speeds to within approximately three knots. A preliminary comparison of cloud trajectories with standard wind observations was presented. Fairly good agreement was found in spite of relatively large differences in location of the compared data. Author

N72-13553*# Wisconsin Univ., Madison.
CONVECTIVE TRANSPORT OF MASS AND ENERGY IN SEVERE STORMS OVER THE UNITED STATES: AN ESTIMATE FROM A GEOSTATIONARY ALTITUDE
D. N. Sikdar, Verner E. Suomi, and C. E. Anderson *In its* Meteorol. Meas. from Satellite Platforms Aug. 1971 p 142-158 refs (See N72-13544 04-20)
Avail: NTIS CSCL 04B

Some important characteristics of intense convection associated with tornado vortices are described in a case study based on photographs of the United States on 19 and 23 April, 1968, that were transmitted from NASA's geosynchronous satellite, ATS 3. The growth rates of a number of convection complexes as estimated from the satellite cloud photographs are studied. Based on a three layer convection model, the upward fluxes of mass and energy in these severe storms are computed. The computed fluxes seem to be higher by at least one order of magnitude than in a moderate thunderstorm. It is suggested that the pronounced growth rate of a convection complex as estimated on the ATS 3 satellite photographs should be an indication of the presence of severe storm cells below the cirrus canopy. Author

N72-13554*# Wisconsin Univ., Madison.
A DEMONSTRATION OF THE INTERCONTINENTAL DISSEMINATION OF GRAPHIC METEOROLOGICAL DATA UTILIZING TELECOPIERS AND RADIO TELEPHONY c07
J. A. Weinman, R. C. Grosh, S. D. Ellington, R. Calheiros (Fundacao Educacional de Bauru, Sao Paulo), G. Ferraz (Fundacao Educacional de Bauru, Sao Paulo), C. W. VanScherpenzeel (Meteorologische Dienst v. Suriname, Paramaribo), and E. Dijra (Meteorologische Dienst v. Suriname, Paramaribo) *In its* Meteorol. Meas. from Satellite Platforms Aug. 1971 p 159-165 (See N72-13544 04-20)
Avail: NTIS CSCL 17B

The feasibility of exchanging graphic meteorological data, such as cloud photographs, between North and South America by means of amateur radio equipment and telecopiers is demonstrated. The cost of such equipment, and the quality of the pictures obtained, compare favorably with other methods currently in use. Author

N72-13555*# Wisconsin Univ., Madison.
THE RADIATION BALANCE OF THE EARTH ATMOSPHERE SYSTEM DURING JUNE AND JULY 1969 FROM NIMBUS 3 RADIATION MEASUREMENTS: SOME PRELIMINARY RESULTS
Thomas H. VonderHaar, E. Raschke (Ruhr Univ.), W. R. Bandeen (NASA. Goddard Space Flight Center), and M. Pasternak (NASA. Goddard space Flight Center) *In its* Meteorol. Meas. from Satellite Platforms Aug. 1971 p 166-174 refs (See N72-13544 04-20)
Avail: NTIS CSCL 04B

The outgoing longwave radiation measured by four channels of the Nimbus 3 satellite radiometer is discussed. The measurements cover the period from June to July 1969. The total outgoing radiation was inferred from spectral measurements by a multiregression method. The method employs limb darkening relations derived by a statistical study of Nimbus 2 measurements. The albedo was inferred from measurements in the spectral range from 0.3 to 4.0 micrometers considering two empirically derived angular dependence relations, one over clouds and land, and the other over oceans through clear skies. Data from periods 16 to 30 June 1969 and 1 to 15 July 1969 yield a mean planetary albedo between 29% and 30% and a mean planetary temperature between 252 to 253 K which corresponds to outgoing fluxes between 0.330 and 0.338 ly/min. Both results are in good agreement with results found from Nimbus 2 measurements of the same semimonthly periods in 1966. Author

N72-13556*# Wisconsin Univ., Madison.
APPLICATION OF SIMULTANEOUS INFRARED RADIATION MEASUREMENTS AND CLOUD PHOTOGRAPHS FROM SATELLITES c14
Thomas H. VonderHaar *In its* Meteorol. Meas. from Satellite Platforms Aug. 1971 p 175-180 refs (See N72-13544 04-20)
Avail: NTIS CSCL 14E

The use of computer produced or photographically averaged cloud depictions based on satellite measurements of reflected solar energy and infrared radiation measurements are discussed. The two measurements are superimposed on a global map and interpreted. The infrared data add a gross estimate of height and/or type of clouds shown by bright areas on the photographic cloud averages. A special advantage of such a technique is the possible extension of methodology to select spectral intervals. E.H.W.

N72-13557# Royal Aircraft Establishment, Farnborough (England).
ARTIFICIAL WEATHER CONTROL
Jun. 1971 23 p Transl. into ENGLISH from La Modification Artificial del Tiempo, report of Comision Nacional de Investigaciones Espaciales, Argentina, 1969
(RAE-LIB-TRANS-1566; UDC-551.578.7:551.515) Avail: NTIS

The possibilities of hail control are discussed, and methods for seeding clouds with chemicals such as silver iodide are described. Details are given of the Argentinian scheme for hail control investigations. Results of experiments carried out in several countries, and data available on the artificial control of hailstorms in Argentina, particularly in Mendoza Province, are reviewed. The activities of the Argentine National Commission for Space Research are also outlined. Author

N72-13558 Department of Supply, Melbourne (Australia). Aeronautical Research Labs.
MEASUREMENT OF EXTREME MECHANICAL TURBULENCE DURING LOW LEVEL FLIGHTS BY MIRAGE A3-76
C. K. Rider, M. R. Thomson, and F. E. Verinder May 1971 11 p refs
(ARL/SM-333) Avail: NTIS

During September 1969 an instrumented Mirage aircraft made 3 flights through an area of severe to extreme turbulence. The turbulence was measured over a period of 5 hours in terms of root mean square gust velocity, power spectral density and rate of exceedence spectra. The vertical gust velocity is well represented by a von Karman spectrum with a root mean square value of 10 ft/sec. and scale length 700 feet. Author

N72-13559# Chicago Univ., Ill. Cloud Physics Lab.
PROJECT WHITETOP: A CONVECTIVE CLOUD RANDOMIZED SEEDING PROJECT. PART 5: STATISTICAL ANALYSES OF THE GROUND LEVEL PRECIPITATION DATA Final Report
John A. Flueck Jun. 1971 314 p refs
(Grants NSF-GA-851; NSF GA-3881; NSF GA-1590; NSF GA-20470)
Avail: NTIS HC $6.00/MF $0.95

A statistical investigation of the effects of cloud seeding on the ground level rainfall and radar precipitation is presented. The amount of ground precipitation and the relative frequency of days with precipitation on the ground are emphasized. The statistical designs, precipitation and partitioning variables used, the steps taken to verify the data, and the general plan, models, and tools of the analyses are described. The pattern of precipitation within the entire research area is examined, and all

rainfall and radar results are shown for both operational days and for wet days. The auxiliary Missouri plume, the restricted Chicago plume, and the rotated three sector statistical designs are also utilized in the data analysis. The operational and wet day rainfall and radar data are reexamined in detail within the framework of the original statistical design. The specialized partitioning variables of plume direction, wind speed, echo height, and total burner hours are included. Results of the rainfall data analysis east and west of the research area are also given.
N.E.N.

N72-13560# National Weather Service, Garden City, N.Y. Scientific Services Div.
USE OF DETAILED RADAR INTENSITY DATA IN MESOSCALE SURFACE ANALYSIS
Robert E. Hamilton Mar. 1971 18 p refs
(NOAA-TM-NWS-ER-40) Avail: NTIS

A case study of a storm is used to illustrate the technique of combining radar and mesoscale pressure analysis. The area of analysis in this study is much greater than what is normally needed or recommended for local use and is presented only to illustrate the larger synoptic pattern. A very detailed radar data analysis is combined with the surface pressure field to reveal small-scale low and high pressure centers and a significant squall line with Line Echo Wave Patterns (LEWP). These small-scale features are usually difficult to discern from the regular or small-scale analysis and in this case only through the use of detailed radar intensity data are the intricate pressure patterns recognizable. Author

N72-13561# Freie Univ., Berlin (West Germany). Inst. fuer Meteorologie und Geophysik.
METEOROLOGICAL DATA. VOLUME 89, NO. 1: METHODS FOR DETERMINING THE CLOUD BASE HEIGHT: DESCRIPTION, USE, ERRORS, AND COMPARISONS Ph.D. Thesis [VERFAHREN ZUR BESTIMMUNG DER HOEHE DER WOLKENUNTERGRENZE: BESCHREIBUNGEN, ANWENDBARKEITEN, FEHLER, VERGLEICHE METEOROLOGISCHE ABHANDLUNGEN, BAND 89, HEFT 1]
Olaf-Wulf Naatz 1970 50 p refs In GERMAN; ENGLISH summary
Avail: NTIS

A survey on nearly all methods of measuring cloud ceilings is given along with instructions for every technique, the limits of application, and wherever possible, formulas and diagrams for calculating and estimating the errors. The different possibilities of cloud base definition are specified and their advantages and disadvantages shown. The estimation of cloud height is discussed and the reason for wrong estimations of more than 100 percent and the possibilities of avoiding most of such errors are given. Three methods of cloud ceiling measurements are compared using X-band vertical radar (a former ppi-radar), stereotelemeter, and a ceilograph (a ceiling projector with pulsed light).
Author (ESRO)

N72-13562# Air Force Global Weather Central, Offutt AFB, Nebraska.
VERIFICATION DATA: AFGWC BOUNDARY LAYER MODEL
Arnold L. Friend 15 Jul. 1971 15 p
(AD-728202; AFGWC-TN-71-3) Avail: NTIS CSCL 04/2

Forecasts produced by the AFGWC Boundary Layer Model are compared with observational data from surface reporting stations as well as gridded verifying analyses for the 600 m level. Summaries include frequency distribution and error statistics for 12 and 24 hour forcasts of wind, temperature, D-value and specific humidity for the month of May 1971. Author (GRA)

N72-13563# Air Force Global Weather Central, Offutt AFB, Nebraska.
VERIFICATION DATA: AFGWC MACRO-SCALE CLOUD MODEL
James Kerlin 26 Jul. 1971 58 p
(AD-728203; AFGWC-TN-71-4) Avail: NTIS CSCL 04/2

Forecasts produced by the AFGWC Macro-Scale Cloud Model are compared with observational cloud and RAWINSONDE data for the area of the N. American NWP grid. Statistical summaries are included for March, April and May 1971. Summaries include frequency distribution and error statistics for 12, 24, 36 and 48 hours forecasts of total cloud coverage, as well as temperatures and dew point depressions at the 850, 700, 500 and 300 mb levels. Author (GRA)

N72-13564# Weather Wing (5th), Langley AFB, Va.
HENZ LEE SLOPE THUNDERSTORM STUDY FOR BUCKLEY ANG BASE AURORA, COLORADO Technical Note, 1966 - 1970
John F. Henz 15 Aug. 1971 19 p refs
(AD-728627; Rept-5WWTN-71-4) Avail: NTIS CSCL 04/2

The report describes a lee slope thunderstorm study for Buckley ANG Base Aurora, Colorado that uses the thermodynamic process of lee slope heating to forecast for the occurrence of thunderstorms in the Buckley area. Author (GRA)

N72-13565# Atmospheric Sciences Lab., White Sands Missile Range, N.Mex.
FORT HUACHUCA, ARIZONA. CENTRAL METEOROLOGICAL OBSERVATORY Meteorological Data Report
Nov. 1970 41 p
(AD-728132) Avail: NTIS CSCL 04/2

The report contains the following meteorological data collected at sites within Fort Huachuca,Arizona, during November 1970: Atmospheric precipitation; Atmospheric temperature; Humidity; Atmospheric pressure; Wind. GRA

N72-13566# Atmospheric Sciences Lab., White Sands Missile Range, N.Mex.
HUNTER-LIGGETT MILITARY RESERVATION, CALIFORNIA, AIRFIELD Meteorological Data Report
Dec. 1970 75 p
(AD-728477) Avail: NTIS CSCL 04/2

The report contains the following meteorological data collected at the airfield within the Hunter-Liggett military reservation, California, during December 1970: Atmospheric precipitation; Atmospheric temperature; Humidity; Wind; Atmospheric pressure. GRA

N72-13567# Atmospheric Sciences Lab., White Sands Missile Range, N.Mex.
PANAMA CANAL ZONE: CERRO TIGRE, FORT GULICK, GAMBOA MET VAN NO. 1 Meteorological Data Report
Dec. 1970 63 p
(AD-728479) Avail: NTIS CSCL 04/2

The report contains the following meteorological data collected at sites within Fort Gulick and Cerro Tigre, Panama during December 1970: Atmospheric precipitation; Atmospheric temperature; Wind; Atmospheric pressure. GRA

N72-13568# Atmospheric Sciences Lab., White Sands Missile Range, N.Mex.
PANAMA CANAL ZONE SKUNK HOLLOW JUNGLE, SKUNK HOLLOW OPEN, SKUNK HOLLOW HUT, JUNGLE MODIFIED Meteorological Data Report
Nov. 1970 37 p
(AD-728480) Avail: NTIS CSCL 04/2

The report contains the following meteorological data collected at sites within the Panama Canal Zone during November 1970: Atmospheric precipitation; Atmospheric temperature; Humidity; Atmospheric pressure; Wind. GRA

N72-13569# Hawaii Univ., Honolulu. Dept. of Meteorology.
SYNOPTIC REGIMES WHICH AFFECT THE INDOCHINA PENINSULA DURING THE WINTER SEASON Final Report, 1 Feb. 1969 - 31 Jan. 1971
Barry E. Harris, James C. Sadler, Gordon Ing, Francis P. Ho, and Walter R. Brett Apr. 1971 100 p refs
(Contract F19628-69-C-0156; AF Proj. 6698-02-01)
(AD-728696; UHMET-71-1; AFCRL-71-0232; DoD-Element-62101F; DoD-Subelement-681000) Avail: NTIS CSCL 04/2

The synoptic weather regimes which affect Southeast Asia during the winter monsoon are identified through case studies utilizing conventional and satellite data. Examples are presented of the recurring regimes which produce operationally significant cloudiness over the climatological cloud minimum areas, and which produce clearing over the area normally covered by persistent stratus. Author (GRA)

N72-13570# Weather Squadron (15th), APO New York 09406 Detachment 19.
TERMINAL FORECAST REFERENCE FILE: LAJES FIELD, AZORES Final Report
Jun. 1971 61 p
(AD-728209) Avail: NTIS CSCL 04/2

The reference file discusses factors affecting the weather at Lajes Field, Azores. Included are location and topography, weather controls, climatic aids, and local forecast studies. Author (GRA)

N72-13571# Naval Postgraduate School, Monterey, Calif.
RESTORATIVE-ITERATIVE INITIALIZATION FOR A GLOBAL PREDICTION MODEL Final Report, Jun. - Sep. 1971
Francis J. Winninghoff 1 Sep. 1971 29 p refs
(Proj. 55309)
(AD-729191; NPS-51WU71081A) Avail: NTIS CSCL 04/2

A restorative-iterative procedure is tested in initializing the height and wind fields for a global barotropic model. Real 500 mb. data is used as the basis of the initial height values in the mid-latitudes and as the basis of the initial streamfunction values in the tropics. The procedure is tested for the case of frictionless and adiabatic flow and for the case where friction and a simulated heating function is included. In addition, experiments were performed in which an "observed" divergent wind was added in the tropics. Results are very encouraging in the sense that the amplitudes of the external inertia-gravity motions excited due to initial imbalance between the mass and wind fields are reduced considerably with the use of the procedure. Author (GRA)

N72-13572# Atmospheric Sciences Lab., White Sands Missile Range, N.Mex.
PANAMA CANAL ZONE. TANK FARM NRL 1, NRL 2, HAWK 1, HAWK 2 Meteorological Data Report
Dec. 1970 60 p refs
(AD-729324) Avail: NTIS CSCL 04/2

The following meteorological data collected at sites within the Panama Canal Zone during December 1970 are presented: atmospheric precipitation, atmospheric temperature, atmospheric pressure, humidity, and wind. GRA

N72-13573# Atmospheric Sciences Lab., White Sands Missile Range, N.Mex.
METEOROLOGICAL TEAM DATA, PANAMA CANAL ZONE. STABILIZATION PONDS, EMPIRE RANGE MET VAN NO. 2 Meteorological Data Report, Dec. 1970
Dec. 1970 46 p
(AD-729323) Avail: NTIS CSCL 04/2

Meteorological data collected at sites within the Panama Canal Zone during December 1970 are presented. GRA

N72-13574# Environmental Technical Applications Center (Air Force), Washington, D.C.
USE OF EXTRAPOLATION IN SHORT-RANGE FORECASTING, CASE STUDY
Robert E. Clark Sep. 1971 17 p refs
(AD-729022; ETAC-TN-71-6) Avail: NTIS CSCL 04/2

The technical note gives the step-by-step procedure for extrapolation of the movement of certain weather phenomena using surface and upper air analyses. Short-range forecasting (0-4 hours) is emphasized and a case study using the technique set forth herein is given for Scott AFB, Illinois. Author (GRA)

N72-13575# Atmospheric Sciences Lab., White Sands Missile Range, N.Mex.
EDGEWOOD ARSENAL, MARYLAND, DECEMBER 1970 Meteorological Data Report
Dec. 1970 75 p
(AD-729308) Avail: NTIS CSCL 04/2

The following meteorological data collected at sites within the Edgewood Arsenal military reservation during December 1970 are presented: atmospheric temperature, atmospheric pressure, humidity, and wind. GRA

N72-13576# Atmospheric Sciences Lab., White Sands Missile Range, N.Mex.
EDGEWOOD ARSENAL, MARYLAND, JANUARY 1971 Meteorological Data System.
Jan. 1971 74 p refs
(AD-729309) Avail: NTIS CSCL 04/2

The report contains the following meteorological data collected at sites within Edgewood Arsenal Military reservation during January 1971: Atmospheric precipitation; Atmospheric temperature; Atmospheric pressure; Humidity; Wind. GRA

N72-13577# Atmospheric Sciences Lab., White Sands Missile Range, N.Mex.
FORT WAINWRIGHT, ALASKA, ALASKA FIELD STATION, FOX LOWER, ARCTIC MEDICAL RESEARCH LABORATORY Meteorological Data Report, Jan. 1971
Jan. 1971 51 p
(AD-729310) Avail: NTIS CSCL 04/2

The following meteorological data collected at sites within Fort Wainwright, Alaska, during January 1971 are presented: atmospheric precipitiation, atmospheric temperature, atmospheric pressure, wind and humidity. GRA

N72-13578# Atmospheric Sciences Lab., White Sands Missile Range, N.Mex.
MAYNARD, MASSACHUSETTS, CENTRAL METEOROLOGICAL OBSERVATORY Meteorological Data Report, Nov. 1970
Nov. 1970 73 p
(AD-729312) Avail: NTIS CSCL 04/2

The following meteorological data collected at the Central Meteorological Observatory in Maynard, Massachusetts, during November 1970 are presented: atmospheric precipitation, atmospheric temperature, atmospheric pressure, humidity, and wind. GRA

N72-13579# Weather Wing (3rd), Offutt AFB, Nebr.
TERMINAL FORECAST REFERENCE FILE, OFFUTT AIR FORCE BASE
Sep. 1971 107 p refs
(AD-729215) Avail: NTIS CSCL 04/2

The publication discusses the location and topography, climatology, and weather regimes affecting Offutt AFB. It also provides a section for forecast studies to objectively aid one in forecasting for Offutt AFB. Author (GRA)

21 NAVIGATION

Includes guidance; autopilots; star and planet tracking; inertial platforms; and air traffic control. For related information see also: 07 Communications.

N72-13580*# Litchford Systems, Northport, N.Y.
BROADCAST CONTROL OF AIR TRAFFIC Quarterly Progress Report
G. Litchford Sep. 1971 67 p refs
(Contract NASw-2247)
(NASA-CR-124696; QPR-1) Avail: NTIS CSCL 17G

Concepts of increased pilot participation in air traffic control are presented. The design of an air traffic control system for pilot usage is considered. The operating and safety benefits of LF/VLF approaches in comparison to current nonprecision approach procedures and systems are discussed. With a good national system plan, flight testing and validation, and the use of local differential, or general diurnal, corrections, the LF/VLF system would provide service superior to that presently available. K.P.D

N72-13581*# International Business Machines Corp., Huntsville, Ala. Electronics Systems Center.
A GUIDE TO ONBOARD CHECKOUT. VOLUME 1: GUIDANCE, NAVIGATION AND CONTROL
Sep. 1971 74 p
(Contract NAS9-11189)
(NASA-CR-115261; IBM-71W-00308-Vol-1) Avail: NTIS CSCL 17G

The results are presented of a study of onboard checkout techniques, as they relate to space station subsystems, as a guide to those who may need to implement onboard checkout in similar subsystems. Guidance, navigation, and control subsystems, and their reliability and failure analyses are presented. Software and testing procedures are also given. K.P.D.

N72-13582*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
ANGULAR MOMENTUM DESATURATION FOR SKYLAB USING GRAVITY GRADIENT TORQUES
Hans F. Kennel 7 Dec. 1971 58 p refs
(NASA-TM-X-64628) Avail: NTIS CSCL 22B

An angular momentum desaturation method for momentum exchange devices of orbiting spacecraft is described. The specific application of the method is to the Skylab which contains three double-gimbaled control moment gyros for precise attitude control and maneuvering. It is assumed that the attitude reference is inertially fixed and that two of the vehicle principal moments of inertia are much larger than the third. Gravity gradient torques and resultant angular momentum accumulation are developed for small deviations from the reference. The assumed moment-of-inertia distribution allows desaturation about all axes with only two attitude angles each for the two axes with large moments of inertia. The necessary desaturation maneuvers can be decoupled for a special set of orbital coordinates. All maneuvers are made during the night portion of the orbit, and the percentage utilized for desaturation is selectable. Expressions for the attitude angle commands are developed assuming infinite vehicle rates. The effect of finite rates introduces an efficiency into the desaturation. Expressions for this efficiency are developed and means for compensation are treated. Arbitrary misalignments between geometric vehicle axes and principal moment-of-inertia axes are permissible. An angle bias about the sun line minimizes the angular momentum accumulation about the sun line projection into the orbital plane. Adaptive desaturation maneuver limiting consistent with the available maneuver momentum is included. Author

N72-13583*# Martin Marietta Corp., Denver, Colo.
CMG ASSEMBLY LIFE TEST AND ENGINEERING EVALUATION TEST, M-509 EXPERIMENT
P. S. Cramer and J. T. Josephson Jun. 1970 35 p
(Contract NAS9-9339)
(NASA-CR-115280; MCR-70-296) Avail: NTIS CSCL 17G

The initial ckeckout of the control moment gyro system for the astronaut stabilizer maneuvering unit is described, and the test results are presented. The life test proceeded smoothly to its completion, and problem areas encountered in the engineering tests are described. These tests included command rate and torquer current transfer, cage and lock, static inverter and signal noise, dynamic response, closed loop drift rate, and gimbal disturbance torque evaluation tests. N.E.N.

N72-13584# Federal Aviation Administration, Washington, D.C. Systems Research and Development Service.
FEDERAL AVIATION RESEARCH AND DEVELOPMENT FOR THE 1970'S
John A. Weber Jun. 1971 24 p Presented at the Am. Soc. for Eng. Educ. Ann. Meeting, Annapolis, 21-24 Jun. 1971
(Event-118) Avail: NTIS

Air transportation forecasts indicate a two-fold traffic increase by 1980 and up to five-fold by 1995. Air traffic of this magnitude requires continuous and orderly development progress in the national air traffic handling capability. The Federal Aviation Administration (FAA) research and development program is directed to meeting the increased demands of the aviation industry by application of advanced technology, particularly automation, and at the same time permitting maximum independence of flight with the highest degree of safety. Selected examples of the FAA R & D technical program are referenced, including air traffic control automation, microwave instrument landing system, and automatic digital data link, among others. Author

N72-13585*# Sperry Rand Corp., Phoenix, Ariz. Flight Systems Div.
STUDY OF AUTOMATIC AND MANUAL TERMINAL GUIDANCE AND CONTROL SYSTEMS FOR SPACE SHUTTLE VEHICLES. VOLUME 1: SECTIONS 1 THROUGH 3 Final Report, Mar. 1970 - Mar. 1971
Stephen Osder and Roger Keller Aug. 1971 168 p ref
(Contract NAS2-5804)
(NASA-CR-114400; Rept-71-0225-01-00-Vol-1) Avail: NTIS CSCL 17G

The results of a study to analyze, design, and evaluate guidance and control systems are presented that start at an altitude of about 100,000 feet and bring the unpowered space shuttle orbiters to a precision horizontal landing. The systems under consideration included fully automatic versions which involve no pilot participation as well as various manual configurations that provide combinations of displays and control augmentation which permit the pilot to control the vehicle to a successful landing. Two classes of vehicles were studied: the low cross range or straight-wing orbiter and the high cross range or delta-wing (delta body) orbiter. The recommended navigation, guidance and control system is shown to be compatible with realistic physical constraints that would exist in space shuttlecraft and to be consistent with the 1971 avionics equipment state of the art. Aircraft capable of aerodynamically simulating the various candidate space shuttlecraft in their unpowered, terminal area descent were investigated, and flight test recommendations, including system mechanizations, are made. Author

N72-13586# National Aviation Facilities Experimental Center, Atlantic City, N.J.
ANALYTICAL STUDY OF THE ADEQUACY OF VOR/DME AND DME/ DME GUIDANCE SIGNALS FOR V/STOL AREA NAVIGATION IN THE LOS ANGELES AREA Interim Report, Jul. 1970 - Jun. 1971
Bernhart V. Dinerman Dec. 1971 152 p
(Contract Proj. 330-014-04X; Proj. 045-390-01X)
(FAA-RD-71-96; FAA-NA-71-45) Avail: NTIS

An analysis was performed to determine the adequacy of very high frequency omnirange/distance measuring equipment

(VOR/DME) guidance signals for vertical/short takeoff and landing (V/STOL) aircraft area navigation (RNAV) in the Los Angeles (LAX) area. Guidance signals were derived from existing VOR/DME and converted VOR facilities. It was concluded that: (1) VOR/DME RNAV over seven approved routes was feasible when using the existing VOR/DME facilities, (2) DME/DME RNAV over the approved routes is feasible when using station-pair combinations from existing VOR/DME facilities and certain converted VOR stations, (3) RNAV using DME/DME was potentially more accurate than VOR/DME, and (4) the number of en route station changeovers for VOR/DME and DME/DME RNAV over the approved and direct routes was considered acceptable. Author

N72-13587*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
LUNAR SURFACE NAVIGATION ANALYSIS
Robert T. Savely and J. Bruce Williamson 5 May 1971 6 p
(NASA-TM-X-67443; MSC-04241; MSC-IN-71-FM-155) Avail: NTIS CSCL 17G

The accuracy of the crew position obtained by using a line-of-sight device such as a sun compass or the rover television camera and the prominent mountains such as Hadley and Hadley delta was investigated. It was determined that with errors of 1 deg (noise only), the crew position kan be obtained to sigma sub phi = 850 feet and sigma sub lambda = 400 feet using Hadley and Hadley delta. The addition of West Mountain reduced the errors to 600 and 400 feet, respectively. Author

N72-13588*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
A METHOD FOR STAR VECTOR DETERMINATION FROM ALIGNMENT OPTICAL TELESCOPE SIGHTING
S. W. Crigler (TRW Systems Group) and T. J. Blucker 30 Jun. 1971 14 p refs
(NASA-TM-X-67470; MSC-IN-71-FM-242; MSC-04446) Avail: NTIS CSCL 17G

A method is described for determining the measured star vector in LM body coordinates when the measurement data consist of a spiral measurement, a cusor measurement, and a time associated with each measurement. The method is defined from alignment optical telescope (AOT) sightings from the LM on the lunar surface. This formulation will be coded into the real-time computer complex off-line AOT and gravity (AOT+G) bench program, the Gravity-Optics LM Attitude and Position (GOLAP) program. Author

N72-13589# National Aerospace Lab., Tokyo (Japan).
PRELIMINARY EXPERIMENTS FOR AUTOMATIC LANDING. 1: ON THE PERFORMANCE TESTS OF RADIO ALTIMETERS
Kazuo Higuchi, Kazuo Higuchi, Yuso Horikawa, Mikihiko Mori, Koichi Ogawa, Mitsuyoshi Mayanagi, Akira Watanabe, and Takayuki Nagoshi Apr. 1971 56 p refs In JAPANESE; ENGLISH summary
(NAL-TR-235) Avail: NTIS

Tests on two radio altimeters, the pulse type and the frequency modulated type, are described. The tests were made using an automatic landing experimental ground tower for simulation tests and a Beechcraft Queen Air 65 aircraft for in-flight tests. Results indicate both altimeters are adequate for automatic landing, and that altimeter signals are not affected by aircraft attitude changes within 30 degrees bank angle. E.H.W.

N72-13590# Compagnie Francaise Thomson Houston-Hotchkiss Brandt, Paris Div. Telecommunications.
MATERIALS FOR THE SCANNING BEAM-DOPPLER CONTROVERSY
P. Fombonne 5 Feb. 1970 23 p
(AT/DTRN/2-155) Avail: NTIS

A comparison was made between a scanning beam and Doppler array type of aircraft landing guidance system. It is shown that an analogy exists between the radiation patterns of a linear array and the signal spectrum received by the same array when the elements are sequentially excited. The transmitted and received spectra of various systems are reviewed including the time reference scanning beam system, the code reference scanning beam system, and the STL Doppler system. No definitive conclusion is reached. ESRO

N72-13591# Genoa Univ. (Italy). Inst. of Machine Applied Mechanics.
A KALMAN-BUCY FILTER FOR RHO-RHO AIR NAVIGATION
Aleramo L. Lucifredi Dec. 1970 13 p refs Submitted for publication Sponsored in part by ESRO
(IIR-71-AL-159) Avail: NTIS

The rho-rho method of position fixing for ground-aided air navigation, using two distance measurements between the airplane and the ground, was optimized by using a Kalman-Bucy filter to increase the precision of the instruments. The digital stochastic filter can automatically and optimally estimate the state variables using the measurements made with auxiliary velocity measuring equipment. The operation of the filter is described and its equations are given for two cases of linearization: around a nominal path, and around the current estimate. ESRO

N72-13592# European Space Research and Technology Center, Noordwijk (Netherlands). Space Science Div.
FEATURES OF THE MAGNETIC ALIGNMENT OF THE ESRO-IA SATELLITE
R. Aiguabella Aug. 1971 34 p
Avail: NTIS

The attitude stability of the magnetically oriented ESRO-IA (Aurorae) satellite has been investigated during the period 10 Oct. to 7 Dec. 1968. Large disturbances appear, making the alignment of the spacecraft with the geomagnetic field vector to exceed the nominal limits, for about 50% of the analyzed orbits which cover reasonably well the above period. The perturbation time is usually much greater than the orbital period (102 min.) and the modulation effects due to the varying intensity or direction of the field along one orbit are shown to be minor. When considering induced drag effects in the upper atmosphere on moving bodies after great geomagnetic storms have taken place, no evidence favoring this explanation of the observed misalignment pattern is found. Extensive and systematic correlation with geomagnetic activity, basically measured by the k sub p index, reveals that variations in average misalignment data are well correlated with the corresponding variations in k sub p provided the time scale they are referred to is sufficiently large. The coupling is such that the degree of correlation remains constant from half day rates onwards. Author (ESRO)

N72-13593# Academy of Sciences (USSR), Moscow. Inst. for Space Research.
A POSTERIORI ALGORITHM FOR FILTERING THE INTERFERING PARAMETERS IN SPACE AUTONOMOUS NAVIGATION
G. A. Mersov 1971 21 p refs
(D-110) Avail: NTIS

The algorithmic determination of navigation parameters for trajectory measurement where the measured quantities are linear combinations of these navigation parameters, and the determination of parameters not directly used in navigation is discussed. If the adopted values of these parameters deviate from the true values, the estimates may be biased and it is necessary to estimate the navigation parameters together with the interfering parameters in order to eliminate this bias. The devised algorithm permits the estimation of an interfering parameter when its estimate exceeds the adopted threshold value. The results demonstrate the efficiency of the algorithm when the interfering parameters which are not equal to zero have an even distribution. ESRO

N72-13594# Human Resources Research Organization, Alexandria, Va.
SURVEY OF FACTORS INFLUENCING ARMY LOW LEVEL NAVIGATION
Robert H. Wright and Warren P. Pauley Jun. 1971 124 p refs
(Contract DAHC19-70-C-0012; DA Proj. 2Q0-62107-A-712)
(AD-728099; HUMRRO-TR-71-10) Avail: NTIS CSCL 17/7

Factors that influence low level navigation and affect Army capability in conducting low level missions were surveyed. The nature of improvements in equipment, procedures, and training needed to provide the Army with effective operational capability in low level navigation were indicated. Major conclusions from the survey include limited capability in low level aerial navigation as affecting future Army combat effectiveness; the rapid reaction mission over unfamiliar terrain in low level navigation; potential improvements in training or procedures for present navigation system and equipment; a simple automatic dead reckoning navigation computer in routine attainment of operationally effective low level navigation performance; and reorienting navigation procedures and training to simplified line of position navigation techniques. Author (GRA)

N72-13595# Epsco, Inc., Westwood, Mass.
STOL AIRCRAFT INSTRUMENT LANDING SYSTEM Final Report
Robert S. Hills Feb. 1971 67 p
(Contract DOT-FA69WA-2098)
(AD-725705; FAA-RD-71-17) Avail: NTIS CSCL 17/7

The development of a microwave scanning beam instrument landing system for STOL aircraft and airports is discussed. It is a flexible system meeting or exceeding category 1 requirements with a growth potential for handling all types of aircraft in categories two and three by modular additions. In azimuth it provides plus or minus 0.5 degree accuracy with pilot selected course width between plus or minus 2 degrees and plus or minus 10 degrees within a 60 degree course sector. A left or right skew course, as well as a centerline course is selectable. In elevation it provides plus or minus 0.1 degree accuracy of a pilot selected glide slope between 3 degrees and 12 degrees and path width of plus or minus 1 to plus or minus 5 degrees. Integral DME functions are provided with an accuracy of plus or minus 0.01 nautical miles. The ground station is entirely dualistic except for antennas. Switch-over from main to standby equipment is controlled by integral dual monitor units operating in parallel.
Author

N72-13797*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
FUTURE POSSIBILITIES IN SPACECRAFT RANGING AND DOPPLER SYSTEMS
Mahlon Easterling *In its* Proc. of the Conf. on Exptl. Tests of Gravitation Theories 1 Nov. 1971 p 166-177 *ref* (See N72-13776 04-30)
Avail: NTIS CSCL 17G

N72-13800*# Stanford Univ., Calif.
DRAG-FREE SATELLITE CONTROL SYSTEM TECHNOLOGY
Daniel B. Debra *In* JPL Proc. of the Conf. on Exptl. Tests of Gravitation Theories 1 Nov. 1971 p 190-196 refs (See N72-13776 04-30)
Avail: NTIS KSCL 17G

N72-13415*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THE MARINER MARS 1971 GIMBAL ACTUATOR
Gerald S. Perkins *In* NASA. Goddard Space Flight Center 5th Aerospace Mech. Symp. 1971 p 185-191 *ref* (See N72-13391 04-15)
(Contract NAS7-100)
Avail: NTIS CSCL 17G

22 NUCLEAR ENGINEERING

Includes nuclear reactors and nuclear heat sources used for propulsion and auxiliary power. For basic research see: 24 Physics, Atomic, Molecular, and Nuclear. For related information see also: 03 Auxiliary Systems; and 28 Propulsion Systems.

N72-13596*# Atomics International, Canoga Park, Calif.
EXPERIMENTAL PHYSICS CHARACTERISTICS OF A HEAVY-METAL-REFLECTED FAST-SPECTRUM CRITICAL ASSEMBLY
W. Heneveld, H., R. K. Paschall, T. H. Springer, V. A. Swanson, A. W. Thiele, and R. J. Tuttle 30 Jul. 1971 354 p refs
(Contract NAS3-12982)
(NASA-CR-72820; AI-71-31) Avail: NTIS HC $6.00/MF $0.95 CSCL 18K

A zero-power critical assembly was designed, constructed, and operated for the purpose of conducting a series of benchmark experiments dealing with the physics characteristics of a UN-fueled, Li-7 cooled, Mo-reflected, drum-controlled compact fast reactor for use with a space-power electric conversion system. The experimental program consisted basically of measuring the differential neutron spectra and the changes in critical mass that accompanied the stepwise addition of (Li-7)3N, Hf, Ta, and W to a basic core fueled with U metal in a pin-type Ta honeycomb structure. In addition, experimental results were obtained on power distributions, control characteristics, neutron lifetime, and reactivity worths of numerous absorber, structural, and scattering materials. Author

N72-13597# Princeton Univ., N.J. Plasma Physics Lab.
LARGE SUPERCONDUCTING MAGNET DESIGNS FOR FUSION REACTORS
J. File, R. G. Mills, and G. V. Sheffield Jun. 1971 8 p refs Presented at the 4th Symp. on Eng. Probl. of Fusion Res., Washington, D. C., 20-23 Apr. 1971
(Contract AT(30-1)-1238)
(MATT-848; Conf-710418-14) Avail: NTIS

Fusion technology will require superconducting fields of larger working volume and higher field strengths than heretofore designed. The forces that will result are so large that novel approaches to magnet design must be developed. This paper describes two complementary approaches that may be combined to yield a satisfactory design for very-high-field toroidal magnets. The first provides a cylindrical load-bearing element in compression combined with return conductors in pure tension. The second follows the design techniques that have been developed in the studies of force-free toroidal magnets.
Author (NSA)

N72-13598# Argonne National Lab., Ill.
CRITICAL REVIEW OF THE ENERGY RELEASED IN NUCLEAR FISSION
J. P. Unik and J. E. Gindler Mar. 1971 54 p refs
(Contract W-31-109-eng-38)
(ANL-7748) Avail: NTIS

Calculations of the total energy released during and following the fission of Th-232, U-233, U-235, U-238, Pu-239, Pu-240, Pu-241, and Pu-242 by neutrons of various energies are presented. Two independent methods of calculation are used. The first method is based on the fact that the total energy released in fission is equal to the difference in energy-equivalent masses of the reactants and the stable fission products. The second method involves the summation of all individual contributions to the total energy release. The total energy absorbed in a reactor is estimated for a particular EBR-II-type reactor. Estimates are also made for the dependence of the total energy releases as a function of neutron energy. The limitations of these calculations and estimates as well as deficiencies in available data are discussed in detail. Author (NSA)

N72-13599# Los Alamos Scientific Lab., N.Mex.
FISSION FRAGMENT ANGULAR DISTRIBUTIONS FOR Th-230, Th-232, Pa-231, AND Pn-239
D. W. Muir Jun. 1971 10 p refs
(Contract W-7405-eng-36)
(LA-4648) Avail: NTIS

Recently published experimental data on the angular distribution of fragments from the neturon-induced fission of Th-230, Th-232, Pa-231, and Pu-239 are fitted with a power series in cos theta. The data, fitting coefficients, and values kalculated at 15 and 80 deg are presented at neutron energies up to 3.0 MeV. (NSA)

N72-13600# Los Alamos Scientific Lab., N.Mex.
PROPOSAL FOR AN INTENSE STEADY STATE NEUTRON SOURCE
L. P. D. King Jul. 1971 13 p refs
(Contract W-7405-eng-36)
(LA-4723) Avail: NTIS

The kinetic intense neutron generator (KING) reactor is an advanced concept which promises to provide a substantial breakthrough in existing steady-state neutron fluxes. The use of a rapidly moving aqueous liquid fuel core removes present steady-state reactor flux limitations since no internal heat exchanger is required. The wide range in uranium fuel concentrations which are permissible in such a system enables one for the first time to optimize both the annular fuel region and control flux trap to give the highest performance index or ratio of thermal flux to reactor power. A conservative 25-MW power level is proposed for the reactor. Thermal neutron flux levels are estimated to be second to none at this power level. The full flux potential for this concept is not known. A 25-MW reactor can serve as a test bed for further studies in which fuel velocities and core transit temperature rise are increased for short times. A description of the KING reactor concept and its dynamic test is presented. Author (NSA)

N72-13601# California Univ., Berkeley. Lawrence Radiation Lab.
MAGNETIC FIELD EFFECTS IN FUSION REACTOR BLANKETS
M. A. Hoffman and G. A. Carlson 15 May 1971 35 p refs Presented at Intersociety Energy Conversion Eng. Conf., Boston, 3-6 Aug. 1971 Sponsored by AEC
(UCRL-72878; Conf-710803-1) Avail: NTIS

The effects considered include magnetic suppression of turbulence and electrical eddy currents induced in the fluid due to spatial variations of either the fluid velocity or the magnetic field strength. The relations were used to estimate the upper bound on the pressure drops of lithium flow in a hypothetical fusion reactor blanket. The results indicate that the pressure drops can span a range of values over six orders of magnitude from less than 0.1 psi to over 100,000 psi, depending on the path through the magnetic field region and the pipe wall conductance. Based on these results, it appears that the pressure drop in a lithium blanket can be made exceptionally small, but only through careful design. As a second example, the approximate pressure drop relations are applied to a novel blanket concept employing heat pipes. Calculations show that heat pipes optimized for operation in the strong magnetic field environment can still have high maximum heat flux capability. Author (NSA)

23 PHYSICS, GENERAL

Includes acoustics, cryogenics, mechanics, and optics. For astrophysics see: 30 Space Sciences. For geophysics and related information see also: 13 Geophysics; 20 Meteorology; and 29 Space Radiation.

N72-13602 British Broadcasting Corp., Kingswood (England). Research Dept.
AUTOMATIC EQUALISATION OF TEMPORARY SOUND CIRCUITS FOR COMMENTARIES: SUBJECTIVE TESTS
W. I. Manson 1971 11 p ref
(BBC-1971/41; EL-56; UDC-534.86:621.395.97) Avail: BBC, Kingswood Warren, Tadworth, Surrey, England

Subjective tests were carried out to determine the necessary circuit bandwidth and, within that bandwidth, the tolerance limits for amplitude/frequency response characteristics appropriate for temporary sound circuits used for commentaries only. It is concluded that the present lower-frequency limit of 50 Hz could be raised to 95 Hz, but that, where possible, the upper-frequency limit should not be below about 7.3 kHz. The present tolerance limits for response could be considerably relaxed at the high- and low-frequency ends of the 95 Hz to 7.3 kHz band. It was confirmed that the limits for wide-range listening conditions are also acceptable when the frequency range is restricted, as it might be, for example, by an MF receiver. Implementation of the revised tolerance limits would raise the success rate for a very simple basic form of equalizer, such as might lend itself readily to automation, from some 87% to about 96%. Author

N72-13603 National Lending Library for Science and Technology, Boston Spa (England).
CALCULATION OF THE MAGNETIC FIELD OF CYLINDRICAL COILS HAVING DIFFERENT CURRENT DENSITIES
L. Cesnak and D. Kabat 28 Jul. 1971 13 p ref Transl. into ENGLISH from Elektrotech. Obz. (Czechoslovakia), v. 59, no. 7, 1970 p 338-342
(NLL-CTO-758-(9091.9F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

Two methods are given for calculating the induction of the magnetic field of a cylindrical coil of uniformly distributed current density. Their application to digital computers is demonstrated, and the rapidities of their calculation are compared. A calculation for a group of coaxial cylindrical coils of different current densities using a combination of the two methods is presented. In conclusion, an example of the calculation for two coils is given. Author

N72-13604# Hamburg Univ. (West Germany).
NUMERICAL TREATMENT OF THE OPTICAL METHOD OF GRADIENT MEASUREMENT
E. Lakatsch 1970 50 p refs In GERMAN; ENGLISH summary (Rept-15) Avail: NTIS

The optical method of gradient measurement which renders possible a very precise determination of the mean vertical refractive-index gradient along a ray path is discussed. The mean height of the respective light beam, and thus the height for which this effective gradient is valid, can only be determined approximately. In that case the actual ray path is replaced by an arc of a circle which shows the same elevation angle at the point of observation, viz. the vertical refractive-index gradient along the light beam is assumed to be constant. An examination is made in model calculations including: the extent this approximation can be applied to logarithmic refractive-index profile and to the power-law profile of the refractive-index gradient, respectively. For this purpose, the differential equation of the ray paths is deduced and its possible solutions are discussed. The propagation paths which were used for the model calculations are given. The method of solving the differential equation is explained and the profiles dealt with are described. In each case the integral presentations deduced for the effective height of the actual ray paths as well as the formulae for the effective height of the corresponding circular light beam are of major importance. The results of the calculations are shown. From these the mean height of the ray paths can be determined accurately with the aid of circular rays. This applies to the logarithmic refractive-index profile as well as to the power-law profile of the refractive-index gradient. Author

N72-13605*# Transportation Systems Center, Cambridge, Mass.
MILLIMETER-WAVE GENERATION WITH SPIRALING ELECTRON BEAMS Technical Report, Jul. 1967 - Dec. 1970
Bernhard Kulke Feb. 1971 101 p refs Sponsored by NASA
(NASA-CR-124716; Code-R1058; DOT-TSC-NASA-71-7) Avail: NTIS CSCL 20N

The feasibility of using the interaction between a thin, solid, spiraling electron beam of 10 to 20 kV energy and a microwave cavity to generate watts of CW millimeter-wave power was investigated. Experimental results are given for several prototype devices operating at 9.4 GHz and at 94 GHz. Power outputs of 5 W, and electronic efficiencies near 3%, were obtained at X band, and moderate gain was obtained at 94 GHz. The small-signal theory gives a good fit to the X-band data, and the device behavior at 94 GHz is as expected from the given beam characteristics. The performance is limited chiefly by the velocity spread in the spiraling electron beam, and once this can be brought under control, high-power generation of millimeter waves appears quite feasible with this type of device. Author

N72-13606# Technische Univ., Berlin (West Germany).
THE CALCULATION OF THE STATIONARY LEVEL MAGNETIC FIELD OF CYLINDRICAL CONDUCTORS BY COMPLEX ANALYSIS Ph.D. Thesis
Juergen Siebert 1970 177 p refs In GERMAN
(D-83) Avail: NTIS

Maxwell equations are used to develop complex linear integral formulas for the vector potential, the magnetic field strength, and the forces, moments, and inductivities in the level magnetic field of a cylindrical conductor. Solutions for a number of complex linear integrals with logarithmic integers are reported as well as the determination of their residues. Calculations are performed for conductors with ellipsoidal and conchoidal contours and for polygonal contours formed by straight lines and circular arcs. Transl. by G.G.

N72-13607# Joint Publications Research Service, Washington, D.C.
CORRELATION METHOD IN HYDROACOUSTICS
21 Dec. 1971 18 p refs Transl. into ENGLISH from the book "Korrelyatsionnyye Izmereniya v Korabelnoy Akust." Leningrad, Sudostroyeniye Press, 1971 p 191-200
(JPRS-54751; CSO-01140/72-P) Avail: NTIS

Correlation methods of phase discrimination and distance determination are discussed. Correlation methods can also be used in systems for the active detection of targets, in which continuous, rather than pulse, radiation is employed. An optical correlator is described which uses a pseudo-random signal for the rapid calculation of the correlation function. K.P.D.

N72-13608*# California Univ., San Diego. Dept. of Applied Physics and Information Science.
NONCOMMUTING OBSERVABLES IN QUANTUM DETECTION AND ESTIMATION THEORY
Helstrom, Carl W. [1971] 10 p refs Submitted for publication
(Grant NGL-05-009-079)
(NASA-CR-122314) Avail: NTIS CSCL 20J

In quantum detection theory, the optimum detection operators must commute; admitting simultaneous approximate measurement of noncommuting observables cannot yield a lower Bayes cost. In addition, the lower bounds on mean square errors of parameter estimates, predicted by the quantum mechanical Cramer-Rao inequality, cannot be reduced by such means.
Author

N72-13609# Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Lab. Nazionali di Frascati.
A HIGH SENSITIVITY METHOD FOR MEASURING MAGNETIC FIELD INTEGRALS
A. Cattomi, M. Piccolo, and F. Ronga 25 Mar. 1971 15 p refs
(LNF-71/12) Avail: AEC Depository Libraries

The design and operation of a magnetometer consisting of a current carrying wire sensed by two piezoelectric crystals for high sensitivity measurements of magnetic field integrals are described. The magnetometer was designed to measure the magnetic field integral along the straight section of the magnetic analyzer at the Adone storage ring to compensate for interference of the magnetic fields from the main magnets and the analyzer magnets. NSA

N72-13610# California Univ., Berkeley.
TABLE OF HYPERFINE FIELDS
Thomas A. Koster and David A. Shirley Nov. 1970 17 p refs Presented at Conf. on Hyperfine Interactions Detected by Nucl. Radiation, Rehovot and Jerusalem, Israel
(Contract W-7405-eng-48)
(UCRL-20411; Conf-700933-5) Avail: NTIS

Fields are tabulated for substitutional impurities in ferromagnetic iron, cobalt, nickel, and gadolinium. Data are given in columns listing elements, host material, temperature, hyperfine field, method of measurement, and reference. NSA

N72-13611# Oak Ridge National Lab., Tenn.
PROTECTION OF LARGE SUPERCONDUCTING COILS
G. Bronca, J. Krikorian, J. Neel, G. Vassal, P. Burnier, and J. Moreau Mar. 1971 12 p refs Transl. into ENGLISH from Nucl. Instrum. Methods (France), v. 79, 1970 p 309-314
(ORNL-TR-2436) Avail: NTIS

When a quenching occurs in a large coil, the dissipation of the energy will increase the temperature of the superconductor and the pressure in the cryostat. The study of these phenomena showed that, using the usual protection device, pressure and temperature can be held at a low value and make the coil safe even if the protection is switched on one second after detection of the quenching. Experimental results obtained on a 10-MJ coil confirm the theory. Author (NSA)

N72-13612# Comitato Nazionale per l'Energia Nucleare, Frascati (Italy). Lab. Nazionali di Frascati.
TESTS OF T-INVARIANCE OF THE ELECTRO-MAGNETIC INTERACTIONS
F. Cannata (Scoula Norm. Super., Pisa, Italy) and F. Strocchi (Scuola Norm. Super., Pisa, Italy) Dec. 1970 12 p refs Presented at the Meeting on Electronsynchrotron, Frascati, Italy, 5-7 Nov. 1970
(LNF-70/55; Conf-701121-5) Avail: AEC Depository Libraries

The experimental situation about C and T invariance in e.m. interactions is reviewed and the implications of the experiments performed so far are discussed. The general feature of the situation is that even if no definite CP (or T) violation effect has been observed in e.m. interactions, one cannot conclude that CP (or T) invariance holds. Tests of T invariance are suggested which look rather promising. Reasonable theoretical estimates show that T-violating effects are not depressed by kinematical or symmetry reasons and that they are expected to be of the order of 30 to 50%. Author (NSA)

N72-13613# Yale Univ., New Haven, Conn.
RADIO FREQUENCY MEASUREMENTS OF INTERACTIONS IN MAGNETIC INSULATORS Ph.D. Thesis
Arne T. Skjeltorp 1971 308 p refs Sponsored by AEC
(YALE-3227-74) Avail: NTIS HC $6.00/MF $0.95

A tunnel diode oscillator with an improved design used to carry out ac susceptibility experiments at radio frequencies is described. The real part of the susceptibility could be measured at frequencies from 0.4 to 100 MHz, at temperatures from 1 to 100 K, and in magnetic fields up to 25 kG. From such measurements one can obtain information on relaxation processes directly, and also the magnetic specific heat from the known thermodynamic relationship between the adiabatic susceptibility and the specific heat. A series of measurements were performed

on three rare earth insulators having a hexagonal lattice structure. The magnetic specific heat was derived for Tb(OH)3 and Gd(OH)3 well above the ferromagnetic and antiferromagnetic ordering temperatures at 3.7 and 0.9 K, respectively. These specific heat data and data from the measurements of the isothermal susceptibilities were used, together with high temperature expansions, to estimate the effective interactions between 1st, 2nd, and 3rd nearest neighbors. Author (NSA)

N72-13614# Southampton Univ. (England). Inst. of Sound and Vibration Research.

[ACTIVITIES OF THE INSTITUTE OF SOUND AND VIBRATION RESEARCH] Annual Report, Apr. 1970 - Mar. 1971

1971 139 p refs

Avail: NTIS

The research activities of the following groups during 1970 are briefly described: (1) acoustics, (2) automotive engineering, (3) fluid dynamics and instrumentation, (4) operational acoustics and audiology, (5) structural dynamics, (6) random data analysis, and (7) the Wolfson Unit for noise and vibration control. Academic awards, courses, and publications of the Institute for 1970/71 are also included. ESRO

N72-13615# Southampton Univ. (England). Inst. of Sound and Vibration Research.

[ACTIVITIES OF THE INSTITUTE OF SOUND AND VIBRATION RESEARCH] Annual Report, Apr. 1969 - Mar. 1970

1970 143 p refs

Avail: NTIS

The research activities of the following groups during 1969 are briefly described: (1) acoustics, (2) automotive engineering, (3) fluid dynamics and instrumentation, (4) operational acoustics and audiology, (5) structural dynamics, (6) random data analysis, and (7) the Wolfson Unit for noise and vibration control. Academic awards, courses, and publications of the institute for 1969/70 are also included. ESRO

N72-13616# Royal Inst. of Tech., Stockholm (Sweden). Div. of Electron Physics.

MULTIPLE SCATTERING OF RELATIVISTIC ELECTRONS IN AIR

Anders Brahme 4 Oct. 1971 36 p refs

(TRITA-EPP-71-22) Avail: NTIS

The multiple scattering of a narrowly collimated electron beam from a 6 MeV microtron accelerator has been studied when the electrons are entering into air at atmospheric pressure and room temperature. Due to the high intensity of the beam, direct measurement of the electron current to a small copper target has been possible. The lateral distribution of electron density has been measured in air at distances up to 2 meters from a thin aluminum window. The experimentally obtained distributions are compared with present theories of multiple scattering. The application of the results to high energy electron therapy is discussed with special reference to the scanning beam method. Author (ESRO)

N72-13617# Royal Inst. of Tech., Stockholm (Sweden). Div. of Electron Physics.

ION BEAN PROBING EXPERIMENT FOR ELECTRIC FIELD MEASUREMENTS

Rolf B. Johansson Oct. 1971 21 p refs

(TRITA-EPP-71-27) Avail: NTIS

The potential distribution in axisymmetric electric fields has been probed by travel time measurements of a reflected ion beam. The accuracy of the evaluated potentials increases with the number of energies used for the time measurements. Nonmonotonic potentials require special treatment, but can be analyzed to some extent. Measurements with both positive and negative ions and option to measure the cut-off energy of transmitted ions of both signs must be included in an improved system. With a superimposed magnetic field, the alignment of both the ion beam and the fields are critical. Author (ESRO)

N72-13618# Atmospheric Sciences Lab., White Sands Missile Range, N.Mex.

ATTENUATION AND DISPERSION OF ACOUSTIC ENERGY BY ATMOSPHERIC DUST

David C. Henley and Glenn B. Hoidale Mar. 1971 59 p refs

(DA Proj. 1T0-61102-b-53-a-18)

(AD-728103; ECOM-5370) Avail: NTIS CSCL 20/1

Insight into the role of atmospheric dust in the attenuation and dispersion of acoustic energy in the lower troposphere is gained by a comparison of theoretical attenuation coefficients and dispersion functions in the 1-10 million Hz range for the mechanisms of classical absorption, molecular absorption, turbulent scattering and dust absorption for three models of atmospheric dust conditions. Over most of this frequency range the attenuation due to dust absorption is masked by one or more of the other attenuating mechanisms, but at the lower frequencies there appear to be physically realizable conditions of high dust concentration and low turbulent scattering wherein dust absorption may become significant. Also, at the lower frequencies the absolute magnitude of the dispersion function due to dust is much greater than that due to classical and molecular absorption. Author (GRA)

N72-13619# Columbia Univ., New York. Dept. of Civil Engineering and Engineering Mechanics.

A CONTINUUM THEORY OF A DIATOMIC, ELASTIC DIELECTRIC

R. D. Mindlin Jul. 1971 39 p refs

(Contract N00014-67-A-0108-0027; NR Proj. 064-388)

(AD-728793; TR-19) Avail: NTIS CSCL 20/12

The field equations and boundary conditions of the continuum theory of elastic dielectrics, including the contribution of the polarization gradient, are extended to apply to a compound material. A formula is obtained for the surface energy of deformation and polarization of a cubic crystal. The solution of a problem of plane waves leads to the identification of transverse and longitudinal optical, as well as acoustical, branches in the dispersion relation. A one-dimensional model of the NaC1-type crystal lattice of shell-model atoms is constructed and its finite difference equations of motion are shown to have the corresponding equations of the continuum theory as their long wave limit, without restriction to low frequency. Author (GRA)

N72-13620# Princeton Univ., N.J. Joseph Henry Labs.

FUNDAMENTAL PROBLEMS IN THEORETICAL PHYSICS Final Technical Report

M. L. Goldberger Jul. 1971 25 p

(Contract AF 49(638)-1545)

(AD-728726; AFOSR-71-2261TR) Avail: NTIS CSCL 20/10

The following topics are discussed: Relativity and astrophysics; Quantum theory of measurement; Mathematical physics; Weak interactions; Solid state physics; Elementary particle physics and high energy phenomena. GRA

N72-13621# Bunker-Ramo Corp., Westlake Village, Calif. Defense Systems Div.

TARGET DETECTION AND IDENTIFICATION PERFORMANCE ON INFRARED IMAGERY COLLECTED AT DIFFERENT ALTITUDES Final Report

Frank A. Maher and James L. Porterfield (AMRL) Wright-Patterson AFB, Ohio AMRL May 1971 27 p refs

(Contract F33615-70-C-1030; AF Proj. 7184)

(AD-728243; AMRL-TR-70-127; Task-718404) Avail: NTIS CSCL 17/5

The study investigated observer tactical target detection and identification performance on displays of downward looking infrared imagery collected at 500-, 1,000-, and 2,000-foot altitudes. Six male college students were tested individually under all three altitude conditions. To balance out learning

effects, a change-over design was used to vary the order of altitude presentations from subject to subject. The different altitude presentations for each subject were spaced a week apart to minimize learning effects. There were 24 target site locations containing a total of 62 individual targets. The five target types used were vehicles, helicopters, missiles, boats, and bridges. An implication from the study is that a relatively high degree of target detection and identification performance can be expected on a display of pictorial-type imagery in which the scene takes as little time as 4 seconds to move across the display screen.
Author (GRA)

N72-13622# Aerospace Corp., El Segundo, Calif. Material Sciences Lab.
OPTICAL DETECTION OF THE MAGNETIC RESONANCE OF COLOR CENTERS Technical Report, Jan. 1969 - Aug. 1970
Harry H. Tippins and Walbert J. Kalinowski 1 Aug. 1971 24 p refs
(Contract F04701-71-C-0172)
(AD-729186; TR-0172(2250-20)-2; SAMSO-TR-71-150) Avail: NTIS CSCL 20/12

Optical detection of magnetic resonance applied to the F-center in KCl is presented. The advantages and the theoretical basis of the technique of optical detection of magnetic resonance are discussed and a description of the details of the actual spectrometer designed for the study of color centers is given. The successful observation of the optical detection of the resonance of the KCl F-center is reported. Author (GRA)

N72-13623# Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.
INFLUENCE OF GAMMA IRRADIATION ON THE ELECTRIC CONDUCTIVITY AND DISACCOMMODATION OF NICKEL-ZINC FERRITE
E. I. Trinkler, E. A. Raytman, and Yu. V. Voropayev 1 Jul. 1971 12 p refs Transl. into ENGLISH from the publ. "Fizicheskiye Svoystva Ferritov" Minsk, Akad. Nauk Belorussk. SSR, 1967 p 150-154
(AD-729044; FTD-MT-24-118-71; DIA-Task-T70-02-01; DIA-Task-T70-01-03) Avail: NTIS CSCL 11/7

Inasmuch as earlier investigations have established an analogy in the behavior of magnetic and electric properties of ferrites in a gamma-radiation field, the authors have carried out a comprehensive study of these properties in one and the same sample (ferrite S-1000). The sample was irradiated with the cobalt K-60000 gamma source of the Physicochemical Institute Im. L. Ya. Karpov at an intensity of 360 R/sec. Measurements were made of the temperature dependence of the electric conductivity, of the magnetic losses, and of the disaccommodation in the range from room temperature to that of liquid nitrogen. The measurement procedures are described. GRA

N72-13624# Army Foreign Science and Technology Center, Charlottesville, Va.
ELECTRO-OPTICAL INTERFERENCE LASER RADIATION MODULATOR
R. A. Kazaryan and E. S. Vartanyan 28 Jul. 1971 12 p refs Transl. into ENGLISH from Uch. Zap. Yerevanskogo Gos. Univ., Ser. Fiz.-Mat. Nauk (USSR), v. 104, 1967 p 55-61
(AD-729220; FSTC-HT-23-999-71; T702301-2301) Avail: NTIS CSCL 20/6

A modulator constructed on the basis of the Rozhdestvenskiy interferometer has been described. Characteristic static curves have been obtained in a modulator working with one or two electro-optical crystals. A comparison of the interference and ordinary amplitude modulators has been given. Author (GRA)

N72-13789*# Stanford Univ., Calif.
SOME FUTURE APPLICATIONS OF LOW TEMPERATURE TECHNOLOGY IN SPACE
William M. Fairbank *In* JPL Proc. of the Conf. on Exptl. Tests of Gravitation Theories 1 Nov. 1971 p 85-88 refs (See N72-13776 04-30)
Avail: NTIS CSCL 20L

N72-13790*# Wesleyan Univ., Middletown, Conn.
LIGHT DEFLECTION
Henry A. Hill (Arizona Univ.) *In* JPL Proc. of the Conf. on Exptl. Tests of Gravitation Theories 1 Nov. 1971 p 89-91 refs (See N72-13776 04-30)
(Grant NSF GP-9295)
Avail: NTIS CSCL 20F

N72-13947# Royal Swedish Academy of Engineering Sciences, Stockholm.
NON-LINEAR OPTICS
In its Develop. in Res. and Technol. during 1970 1970 p 63-65 refs In SWEDISH (See N72-13942 04-34)
Avail: NTIS; Almqvist & Wiksell, Stockholm: 25 Kr

N72-13959# Royal Swedish Academy of Engineering Sciences, Stockholm.
MODERN OPTICS
In its Develop. in Res. and Technol. during 1970 1970 p 160-168 refs In SWEDISH (See N72-13942 04-34)
Avail: NTIS; Almqvist & Wiksell, Stockholm: 25 Kr

24 PHYSICS, ATOMIC, MOLECULAR, AND NUCLEAR

Includes atomic, molecular, and nuclear physics. For applications see: 22 Nuclear Engineering. For related information see also: 29 Space Radiation.

N72-13625 Tata Inst. of Fundamental Research, Bombay (India).
LECTURES ON THE MICROSCOPIC THEORY OF NUCLEAR STRUCTURE
V. Gillet 1970 205 p refs
Copyright. Avail: Issuing Activity

The microscopic theory of nuclei accounts for all nuclear properties, starting from the interactions between nucleons. It is based on two postulates: The degrees of freedom associated with the meson field in nuclei may be replaced by potentials (including exchange forces) between nucleons, and two body forces are preponderant. It is difficult to justify these two hypotheses, than otherwise by pointing out the absence of effects depending essentially upon their violation. Thus the microscopic theory is founded on a nuclear Hamiltonian for a system of A-nucleons, where M is the nucleon mass (neglecting for simplicity the proton-neutron mass difference), and Pi the momentum operator of particle i, and V sub ij is a two-nucleon potential acting between particles i and j. Author

N72-13626# Electrotechnical Lab., Tokyo (Japan).
FUNDAMENTAL DATA ON RADIATION PHYSICS 1
Haruo Sugiyama Dec. 1970 125 p refs In JAPANESE; ENGLISH summary
(Circ-170) Avail: NTIS

A data book concerning interaction of radiation with matter for scientists and engineers engaged in radiation dosimetry or related fields is presented. The main contents are: (1) radiation quantities and units, (2) photon attenuation coefficients, (3) electron stopping power and range, (4) proton stopping power and range, (5) energy spectra of bremsstrahlung photons, (6) backscattering of electrons and photons, (7) slowing down spectra of electrons, (8) electron energy dissipation curves, and (9) w values. Author

N72-13627# Electrotechnical Lab., Tokyo (Japan).
ION IMPLANTATION AND ITS APPLICATIONS: REVIEW OF CURRENT RESEARCH AND DEVELOPMENT
Ioshio Tsurushima and Hisao Tanoue Dec. 1970 125 p refs In JAPANESE; ENGLISH summary
(Circ-171) Avail: NTIS

Recent investigations on the range-energy relation and the depth distribution of implanted ions are reviewed. Theoretical considerations on the electronic stopping mechanisms and spatial distribution of energy deposited into atomic processes in ion implanted materials are also reviewed. Data cover doping of electrically active ion species in substrate materials, lattice disorder and radiation damage, effects of high energy protons on semi-insulating layers in compound substances, and anneal behavior of lattice disorder, anneal characteristics of dopant activities, high temperature implantation, and radiation enhanced diffusion. E.H.W.

N72-13628# Eidgenossische Technische Hochschule, Zurich (Switzerland).
THE INJECTION OF A 72-MeV PROTON BEAM INTO THE SIN-RING CYCLOTRON AND ITS ACCELERATION Ph.D. Thesis
Herbert Braun 1971 119 p refs In GERMAN; ENGLISH summary
(Diss-4593) Avail: NTIS

Conventional injection through a magnetic and electrostatic inflector channel, and precessional injection with a first harmonic field component and without the electric channel are described. The superposition of the sector field with the field of the magnetic inflector channel produces a stray field which has to be compensated within the short distance of half a gap-width. A general design principle for such a self compensated magnetic channel is given. The acceleration of a beam centered on an equilibrium orbit produces a coherent oscillation. An ideal orbit exists which exhibits only negligible oscillations due to the energy gain. The injection path should be centered on to this orbit. The acceleration voltage varies with radius. This causes an alternating magnetic field which influences the phase width of the particle bunch. For small phase angles the phase width varies reciprocally with the accelerating voltage. Author

N72-13629# Nice Univ. (France). Lab. de Physique Theorique.
LONGITUDINAL PHASE SPACE AND HELICITY CONSERVATION IN DIFFRACTIVE RESONANCE PRODUCTION
Jean-Louis Meunier and Guy Plaut Dec. 1971 26 p refs
(N-TH-71/7) Avail: NTIS

Recent experimental results on helicity conservation in A sub 1 production are examined using a reggeized Deck model similar to that proposed by Berger. It is shown that this model, which conserves neither s-channel nor t-channel helicity, is able to reproduce the isotropic azimuthal distributions found experimentally, when the events are selected according to their location on a longitudinal phase space (LPS) plot. The approximate isotropy of these distributions cannot be considered as conclusive evidence in favor of helicity conservation, and it is pointed out that the LPS-selection of events can hide important features of the experimental results. Author

N72-13630*# Louisiana State Univ., Baton Rouge. Dept. of Physics and Astronomy.
NUCLEAR ELECTROMAGNETIC CASCADES FROM ALPHA PARTICLES INCIDENT ON AN IRON ABSORBER
W. V. Jones [1971] 6 p refs
(Contract NAS9-10986; Grant NGR-19-001-012)
(NASA-CR-124698; OG-56) Avail: NTIS CSCL 18H

Mean values and fluctuations of the nuclear-electromagnetic cascade development resulting from alpha particles incident on an iron absorber was determined for the primary energy range 10 to 300 GeV/nucleon. This has been accomplished by using a three-dimensional Monte Carlo simulation of the cascade process. The model used was first adjusted until it gave predictions for a small ionization spectrometer which agreed with measurements obtained by exposing the same spectrometer to 10, 20.5, and 28 GeV/c protons at an accelerator. The calcuations were then modified to apply to high energy alpha particles. The results show that measurements of the energies of alpha particles incident on an iron spectrometer with six interaction lengths total depth can be made with accuracies ranging from approximately 5% at 300 GeV/nucleon to approximately 16% at 10 GeV/nucleon. Author

N72-13631*# Louisiana State Univ., Baton Rouge. Dept. of Physics and Astronomy.
MEASUREMENT OF THE NUCLEAR ELECTROMAGNETIC CASCADE DEVELOPMENT IN GLASS AT ENERGIES ABOVE 200 GeV
C. R. Gillespie, R. W. Huggett, D. R. Humphreys, W. V. Jones, and L. B. Levit [1971] 5 p refs
(Grant NGR-19-001-012)
(NASA-CR-124697; HE-58) Avail: NTIS CSCL 18H

The longitudinal development of nuclear-electromagnetic cascades with energies greater than 200 GeV was measured in a low-Z (glass) absorber. This was done in the course of operating an ionization spectrometer at mountain altitude in an experiment to study the properties of gamma rays emitted from individual interactions at energies around 10,000 GeV. The ionization produced by a cascade is sampled by 20 sheets of plastic scintillator spaced uniformly in depth every 2.2 radiation lengths. Adjacent pairs of scintillators are viewed by photomultipliers which measure the mean ionization produced by an individual cascade in 10 layers each 1.1 interaction length (4.4 radiation lengths) thick. The longitudinal development of the cascades was measured for about 250 cascades having energies ranging from 200 GeV to 2500 GeV. The observations are compared with the predictions of calculations made for this specific spectrometer using a three-dimensional Monte Carlo model of the nuclear-electromagnetic cascade. Author

N72-13632*# Louisiana State Univ., Baton Rouge. Dept. of Physics and Astronomy.
COMPARISON OF THE ENERGY RESPONSE OF AN IONIZATION SPECTROMETER FOR PIONS AND PROTONS
W. V. Jones and S. D. Verma [1971] 5 p refs
(Grant NGR-19-001-012)
(NASA-CR-124729; HE-36) Avail: NTIS CSCL 18H

An ionization spectrometer consisting of a sandwich of iron absorbers and plastic scintillation counters was used to measure the energy of pions and protons in the interval 10 to 1000 GeV. For the limited energy interval of 10 to 40 GeV, pions and protons were identified by an air cerenkov counter. Interactions in carbon were studied in a multiplate cloud chamber placed between the cerenkov counter and the spectrometer. Knowledge of these interactions were used in conjunction with a Monte Carlo simulation of the cascade process to study differences in the response of the spectrometer to pions and protons. Author

N72-13633# Tokyo Univ. of Education (Japan). Dept. of Physics
INCLUSIVE REACTION IN THE MULTIPERIPHERAL MODEL 1 (PION AND KAON DISTRIBUTIONS IN THE PIONIZATION REGION)
Sunao Sakai Nov. 1971 24 p refs
(TUEP-71-47) Avail: NTIS

Inclusive single particle distribution in the pionization region is investigated in the multiperipheral model. The model fits the structures of pi distribution quite well as well as the K distribution with only one parameter. The ratios d sigma(K)/d sigma(pi) have the K2 dependence. The K/pi ratio becomes 0.25, which is in good agreement with the cosmic ray data. Author

N72-13634# Illinois Univ., Urbana. Dept. of Physics.
NUMERICAL CALCULATION OF INCLUSIVE SPECTRA AND CORRELATIONS IN A PHI 3 LADDER MODEL

Fritz W. Bopp [1971] 29 p refs
(Grant NSF GP-25303)
(ILL-(TH)-71-12) Avail: NTIS

A numerical calculation of the inclusive one and two particle spectra and the two particle correlation function at several energies for ladder diagrams in a lamda phi 3 field theory is reported. Author

N72-13635# Illinois Univ., Urbana. Dept. of Physics.
MULTIPERIPHERAL BOOTSTRAP MODEL WITH SU(3) MULTIPLETS
H. W. Wyld [1971] 21 p refs Revised Prepared in cooperation with CERN
(Grant NSF GP-25303)
(CERN-TH-1361-Rev.) Avail: NTIS

The ABFST multiperipheral bootstrap model, studied recently by various authors with SU(2) multiplets (rho mesons and f mesons etc., exchanged between pions), is enlarged to use SU(3) multiplets (octets of vector mesons, nonets of tensor mesons etc., exchanged between octets of pseudoscalar mesons). It is found that this increases the effective strength of the interaction slightly, but not enough to yield output trajectories with the correct intercepts. The calculation appears to yield f and f' trajectories but no Pomeron trajectory. Exchange degeneracy is broken for the output trajectories in this type of model in which an interaction potential is iterated, and this seems to be a serious difficulty. Author

N72-13636# Illinois Univ., Urbana. Dept. of Physics.
INVARIANT AMPLITUDES FOR STUDYING THE PARITY CONZENT OF DUALITY
Lorella Jones Nov. 1971 24 p refs
(Grant NSF GP-25303)
(ILL-(TH)-71-14) Avail: NTIS

Kinematic singularity free parity conserving helicity amplitudes are used to obtain a new set of amplitudes. These new amplitudes can be approximated in any dynamical theory; they have the advantage that resonances with definite parity frequently decouple from certain amplitudes. This simplifies study bf the parity content of duality. New amplitudes for the reactions nucleon antinucleon yields nucleon antinucleon and rho meson pion yields pion rho meson. Using these amplitudes, a Veneziano-like model is formulated for these reactions with the additional requirement that each trajectory have unique quantum numbers - i.e., no conspiracies are allowed. In nucleon antinucleon it was found that no pi-like trajectories can participate in such a bootstrap. Results for rho meson pion scattering are less striking, but the reduction of number of terms due to parity requirements is easily demonstrated. Author

N72-13637# Illinois Univ., Urbana. Dept. of Physics.
SOME SIMPLE RESULTS ON THE DUALITY OF NON-PARITY-DOUBLED SYSTEMS
Lorella Jones [1971] 11 p refs
(Grant NSF GP-25303)
Avail: NTIS

It was shown that in some cases the crossing relations and kinematic behavior of helicity amplitudes alone suffice to rule out combinations of mutually bootstrapping trajectories. In particular, no set of g = - natural parity trajectories can bootstrap itself in the reaction pion rho meson yields rho meson pion; and no set of meson trajectories of definite (natural or unnatural) parity can be self-dual in baryon-antibaryon or quark-antiquark scattering. The techniques described are most useful when the number of independent helicity amplitudes involved in the reaction is small, and several of these can be associated with definite parity for exchanged trajectories. Author

N72-13638# Stanford Univ., Calif. Dept. of Applied Physics.
THE ORBITAL CORRECTION METHOD
Walter A. Harrison [1971] 36 p refs Sponsored in part by ARPA and NSF
Avail: NTIS

The method for calculating the total energy of complex systems is a perturbation expansion with two novel features. First, the starting point is an approximate state and the expansion is in the orbital correction to that state. This permits application to complicated molecules where there is no soluble unperturbed Hamiltonian resembling the real system. The second feature is the evaluation of the total energy without the diagonalization of a Hamiltonian matrix. This is accomplished in a way analogous to the use of the invariance of a trace under a similarity transformation. This permits treatment of arbitrarily large systems. The principal approximations are a self-consistent field approximation to the electron-electron interaction and the truncation at second order of an expansion which would be exact if carried to all orders. Applied to metals, with the approximate starting states taken as OPWs, the theory becomes rigorous nonlocal pseudopotential theory. In molecules LCAO starting states are envisaged and the theory is a systematic improvement upon and simplification of LCAO theory. Author

N72-13639# Stanford Linear Accelerator Center, Calif.
STABILITY OF THE PHASE MOTION OF MANY BUNCHES IN CHARGED-PARTICLE STORAGE RINGS
M. M. Karliner May 1971 22 p refs Transl. into ENGLISH from Russian report IYAF-45-70, Novosibirsk, USSR, 1970 18 p Sponsored by AEC
(SLAC-Trans-132; IYAF-45-70) Avail: NTIS

The conditions for the stability of the phase motion of a large number of bunches in a relativistic storage ring when the beam interacts electromagnetically with the external system were investigated. For the most characteristic case of identical bunches whose number is equal to the radio frequency factor, stability conditions are obtained in the form of a set of inequalities, each of which ensures the stability of the corresponding symmetric oscillation mode. The case of several bunches is analyzed in comparison with the case of a single bunch. An expression is given for the instability growth rates for symmetric modes. Author (NSA)

N72-13640# Oak Ridge National Lab., Tenn.
NEUTRON ENERGY-DEPENDENT CAPTURE GAMMA-RAY YIELDS IN TANTALUM AND TUNGSTEN
K. J. Yost, J. E. White, C. Y. Fu, and W. E. Ford, III 7 Jun. 1971 36 p refs
(Contract W-7405-eng-26)
(ORNL-TM-3436) Avail: NTIS

Gamma ray yields as a function of neutron energy for tantalum and tungsten are calculated with the cascade code DUCAL. The results are presented in a format that would facilitate use in coupled neutron-gamma ray transport calculations. In the case of tungsten, pronounced variations in the capture yield spectra were noticed above 3.0 MeV. On the other hand, only slight variations in the yield spectra were evident for tantalum. The results are compared with integral gamma ray yield measurements, and the agreement is favorable.
Author (NSA)

N72-13641# Institute of Nuclear Research, Warsaw (Poland).
THE (n, ALPHA) REACTIONS ON HEAVY NUCLEI INDUCED BY 14.2 MeV NEUTRONS
M. Jaskola, W. Osakiewicz, J. Turkiewicz, and L. Zemlo 1971 10 p refs
(INR-1268) Avail: AEC Depository Libraries

The energy spectra of alpha particles from the (n, alpha) reaction with Te-122, La-139, Tb-159, Dy-161, Dy-163, Dy-164, Er-166, Er-168, and Tm-169, induced by 14.2-MeV neutrons, were measured using the semiconductor-detector technique. The analysis of the energy spectra leads to the conclusion that the evaporation theory is inadequate to describe the investigated reactions. The shapes of the experimental spectra suggest the presence of strong direct effects. Author (NSA)

N72-13642# Oregon Univ., Eugene. Inst. of Theoretical Science.
A DEVICE TO PRODUCE HIGH CENTER-OF-MASS ENERGY e+e COLLISIONS: ACCELERATOR BEAM COLLIDING WITH A STORED BEAM
Paul L. Csonka and John R. Rees Apr. 1971 23 p refs Submitted for publication Sponsored by AEC Prepared in cooperation with Stanford Linear Accelerator Center
(RLO-2041-56; SLO-PUR-856) Avail: NTIS

If 20-GeV electrons collide with 2-GeV electrons (or positrons) circulating in the storage ring under construction, then the reaction center of mass energy will be E sub cm = 12.6 GeV. The luminosity of this device is calculated to be about 2.4 X 10 to the 29th power/sq cm sec, and the number of e + e yields e + e + X reactions at this energy is estimated to be about 60/hour when X = muon(+) + muon(-), about 10/hour when X = pion(+) + pion(-), and about 1/hour when X = pion(0) or eta meson. Author (NSA)

N72-13643# Addis Translations International, Woodside, Calif.
EFFECT OF AN INTERNAL TARGET ON THE DYNAMICS OF THE BEAM IN A STORAGE RING
I. D. Adeishvili, I. A. Grishaev, V. P. Kozin, N. I. Mocheshnikov, A. E. Tolstoi, and A. M. Shenderovich Feb. 1971 15 p refs Transl. into ENGLISH from Akad. Nauk Ukrainskoi SSR, Kharkov. Fiz.-Tekhn. Inst., report KHFTI-70-29 Sponsored by AEC Prepared for UCRL, Berkeley
(UCRL-Trans-1436; KHFTI-70-29) Avail: NTIS

Experimental results from a study of the influence of different targets on the beam in the storage ring at the Engineering Physics Institute of the Academy of Sciences of the Ukrainian SSR are reported. The results obtained on the beam lifetime as a function of the target dimensions confirm the possibility of using a storage ring's circulating beam in nuclear experiments, and permit a choice among the different targets required for different experiments. Author (NSA)

N72-13644# Kernforschungszentrum, Karlsruhe (West Germany). Zyklotron-Lab.
MEASURED DIFFERENTIAL CROSS SECTIONS FOR ELASTIC AND INELASTIC SCATTERING OF 104-MeV ALPHA PARTICLES
D. Habs, G. Hauser, Gudrun Hoffmann, H. Klewe-Nebenius, R. Loehken, Uta Martens, H. Rebel, G. Schatz, G. W. Schweimer, and J. Specht Oct. 1970 69 p refs
(NP-18920) Avail: AEC Depository Libraries

Measured differential cross sections for elastic and inelastic scattering of 104-MeV alpha particles are presented in numerical tables. Author (NSA)

N72-13645# Institute of Nuclear Research, Warsaw (Poland).
CIRCULAR POLARIZATION OF GAMMA RAYS
W. Ratynski 1971 85 p refs In POLISH
(INR-1262) Avail: AEC Depository Libraries

Methods of thermal-neutron polarization are reviewed, and procedures for the analysis of polarized-neutron capture gamma rays are given. The results of some spin measurements in excited nuclei of Al-28, Ga-70, Ga-72, W-183, and W-187 are included. Author (NSA)

N72-13646# California Univ., Berkeley. Lawrence Radiation Lab.
ISOSPIN PURITY AND VIOLATIONS OF MIRROR SYMMETRY: THE BETA-DELAYED PROTON DECAY OF C-9, O-13, Ne-17, AND Ar-33 Ph.D. Thesis
John Edward Esteri Mar. 1971 111 p refs
(Contract W-7405-eng-48)
(UCRL-20480) Avail: NTIS

Beta-delayed proton studies of some light A = 4n + 1, T sub z = -3/2 nuclei were made, with supplementary gamma ray measurements where necessary. A fast gas transport system and particle identification techniques together produced proton spectra in which the resolution was limited by the momentum spread of the preceding beta ray. The half lives of C-9, O-13, Ne-17, and Ar-33 were measured. Precise energy levels in F-17 and Cl-33 were obtained, and a discrepancy in F-17 levels was resolved. Absolute log-ft values for the beta decay branches of O-13, Ne-17, and Ar-33 were also obtained. These measurements indicate violations of mirror symmetry in beta decay and that the lowest T = 3/2 state in F-17 has an isospin purity of 95% or more, in contrast to the lowest T = 3/2 state in Cl-33, for which about 90% purity is suggested. Circumstantial evidence indicates that four T = 1/2 states within 350 keV of the analog state cause the impurity observed in Cl-33. Author (NSA)

N72-13647# Institute of Nuclear Physics, Krakow (Poland).
DISTORTED WAVE BORN APPROXIMATION PROGRAMMES FOR INELASTIC SCATTERING OF CHARGED PARTICLES MIS-0, MIS-2, MIS-3, MIS-4 AND MIS-5
Kobos Andrzej Feb. 1971 49 p refs
(INP-746) Avail: AEC Depository Libraries

The MIS-0, MIS-2, MIS-3, MIS-4, and MIS-5 programs, written in the MAT-4 autocode language for the Soviet MINSK-22 computer, are presented. The programs calculate, in the distorted-wave Born approximation, the reduced differential cross section for inelastic scattering of charged particles, for excitations with orbital angular momentum transfer values of 0,2,3,4, and 5, respectively. Author (NSA)

N72-13648# Institute of Nuclear Research, Warsaw (Poland).
CLOSED SHELLS FOR VERY HEAVY NUCLEI
A. Sobiczewski, T. Krogulski, J. Blocki, and Z. Szymanski 1970 36 p refs
(INR-1270) Avail: AEC Depository Libraries

Neutron and proton single-particle energies in the Woods-Saxon potential are calculated for a wide region of the mass number A approximately 200 to 600. Considerable energy gaps at neutron numbers N = 228, 308, and 406 (besides the gaps at N = 126 and 184) and at proton number Z = 164 (besides the gaps at Z = 82 and 114) are found. Smaller gaps or low level densities are observed at Z = 154 and 204. The sensitivity of the gaps obtained to the variations of the potential parameters is discussed. Author (NSA)

N72-13649# Paris Univ., Orsay (France). Faculte des Sciences.
STUDY OF THE (p,px) REACTION WITH LIGHT NUCLEI AT 156 MeV Ph.D. Thesis
Daniel Bachelier 1970 74 p refs In FRENCH
(NP-18880; FRNC-TH-35; CNRS-AO-5636) Avail: AEC Depository Libraries

The angular correlations of the quasi-elastic scattering reactions Li-6(p,pd)He-4, Li-6(p,p He-3)H-3, Li-7(p,pt)He-4, and C-12(p,pd)B-10, and the energy spectra of the residual nucleus in the C-12(p,pd)B-10 reaction, were studied. Improvements in thick semiconductor detector technology and on-line computers led to the development of an experimental technique. The results show the ratio of the probabilities of finding the Li-6 nucleus in the form (He-4 + H-2) to the form (He-3 + H-3) is 0.43 and the probabilities of finding Li-6 in the form (He-4 + H-2) and Li-7 in the form (He-4 + H-3) are equal. In the C-12(p,pd)B-10 reaction, when the flip-spin is negligible, the nuclear levels excited are at 0.72 MeV, 2.15 MeV, and, to a lesser degree, around 15 MeV. The spectrum obtained is in good agreement with the theoretical predictions made from the intermediate-cooling shell model. NSA

N72-13650# Joint Inst. for Nuclear Research, Dubna (USSR). Lab. of Nuclear Problems.
ALPHA DECAY OF NEUTRON-DEFICIENT RADON ISOTOPES
N. A. Golovkov, R. N. Ivanov, A. Kolachkovski, Yu. V. Norseev, and V. G. Chumin 1971 21 p refs In RUSSIAN
(JINR-P6-5791) Avail: AEC Depository Libraries

The alpha decay of Ra isotopes with A = 206 to 212,

which were separated with a mass separator, was studied, using a magnetic alpha spectrograph. New alpha transistions to levels of the daughter nuclei were obtained. Author (NSA)

N72-13651# Danish Atomic Energy Commission, Risoe. Research Establishment.
PHYSICS DEPARTMENT Annual Progress Report, 1 Jan. - 31 Dec. 1970
H. Bjerrum Moeller and Per-Anker Lindgard Jan. 1971 46 p refs
(RISO-237) Avail: AEC Depository Libraries

Research during the period Jan. through Dec. 1970 is reported on the five following main fields: (1) solid-state physics, (2) plasma physics, (3) nuclear spectroscopy, (4) radiation damage, and (5) meteorology. NSA

N72-13652# Oak Ridge National Lab., Tenn.
STUDY OF THE OVERLAP CONDITIONS REQUIRED IN SEQUENTIAL DISCRETE ORDINATES TRANSPORT CALCULATIONS FOR A 14 MeV NEUTRON SOURCE IN A 5000-m RADIUS CYLINDER OF AIR
J. V. Pace, III, F. R. Mynatt, and Lorraine S. Abbott 9 Jun. 1971 13 p refs Sponsored by AEC
(ORNL-TM-3269; CTC-40) Avail: NTIS

The overlap conditions were studied in a series of calculations with the one-dimensional code ANISN for the case of an infinitely long cylinder of air and a 14-MeV neutron source on the cylinder axis. Radial distances out to 5000 m were covered both in a single ANISN run and in a series of runs for a central cylindrical core and several successive cylindrical annuli. The results showed that for this problem a 500-m overlap is required unless boundary albedos are introduced in the runs, in which case the overlap is reduced to 30 m. The boundary albedos are based on the incoming and outgoing currents determined for the boundary locations in the single ANISN run. For a large DOT calculation involving a source spectrum, using the albedos would substantially reduce the number of runs required to complete the calculation. Author (NSA)

N72-13653# Oak Ridge National Lab., Tenn.
PREPARATION OF DATA SETS IN ENDF FORMAT FOR Na, Mg, Cl, ND K FOR USE IN SHIELDING CALCULATIONS
R. W. Roussin, S. K. Penny, V. A. Singletary, and J. B. Wright 27 May 1971 13 p refs
(ORNL-TM-3429; ENDF-151) Avail: NTIS

Neutron interaction and gamma ray production cross sections for sodium, magnesium, potassium, and chlorine, were placed in the currently approved ENDF/B formats. This involved a format change for the neutron files and two format changes for the gamma ray production files. Gamma ray interaction cross sections were then added to the neutron interaction and gamma ray production data to obtain a reasonably complete set of data for use in shielding calculations. Author (NSA)

N72-13654# Atomic Energy Commission, New York. Health and Safety Lab.
APPENDIX TO FALLOUT PROGRAM QUARTERLY SUMMARY REPORT, 1 MARCH - 1 JUNE 1971
1 Jul. 1971 408 p
(HASL-243-App) Avail: NTIS HC $6.00/MF $0.95

Data collected through the activities of the Fallout Program of the Health and Safety Laboratory are presented in tabular form. The following data are included and are presented as average monthly values from the beginning of the monitoring program through the data indicated: the Sr-89 and Sr-90 deposition at world land sites through December 1970; the Sr-90 deposition at Atlantic Ocean weather stations through December 1970; the fallout radionuclide and stable lead contents of the surface atmosphere in the Western Hemisphere through October 1970; the Sr-90 content of fresh and powdered milk in New York through March 1971; and the Sr-90 content of New York City tap water through March 1971. A list of the conversion factors used in the processing of the data and a table of half life values for radionuclides of interest in the fallout program are also included. NSA

N72-13655# United Kingdom Atomic Energy Authority, Culham (England).
HIGH-CURRENT TECHNIQUES IN PRESENT-DAY NUCLEAR FUSION RESEARCH AND DEVELOPMENT (PARTS 1 AND 2)
H. Bertele and J. Mitterauer May 1971 83 p refs Transl. into ENGLISH from Elektrotech. Maschinenbau (Berlin), v. 87, 1970 p 139-152; 304-313; 343-353
(CTO-752) Avail: AEC Depository Libraries

A brief review is given of the principles of nuclear fusion and the generation, heating, and confinement of thermonuclear plasma. This review is based on a systematic analysis of the electrical engineering problems of fusion research. NSA

N72-13656# Oak Ridge National Lab., Tenn.
INDEXED BIBLIOGRAPHY ON EFFECTS OF RADIONUCLIDES AND IONIZING RADIATION ON ECOLOGICAL SYSTEMS
G. U. Ulrikson, C. D. Bopp, and R. M. Carroll Aug. 1971 385 p refs
(Contract W-7405-eng-26)
(ORNL-NSIC-95) Avail: NTIS HC $6.00/MF $0.95

An annotated list is presented of some 3000 references to the literature on the effects of ionizing radiations on aquatic and terrestrial animal and plant ecosystems and the transport of radioisotopes through ecosystems and food chains. Author and keyword indexes are included. NSA

N72-13657# Rome Univ. (Italy). Inst. of Physics
EXACT SOLUTION OF A TIME-DEPENDENT QUANTAL HARMONIC OSCILLATOR WITH A SINGULAR PERTURBATION
P. Camiz, A. Gerardi, C. Marchioro, E. Presutti, and E. Scacciatelli 14 Jan. 1970 19 p refs Sponsored partly by Consiglio Nazl. delle Ric.
(Nota-Interna-301) Avail: NTIS

The quantal problem of a particle interacting in one dimension with an external time dependent quadratic potential and a constant inversely quadratic potential is exactly solved. The solutions are found both in the Schroedinger representation by using a generating function or a time dependent raising operator, and in the Heisenberg picture. They depend only on the solution of the classical harmonic oscillator. The generalizations to the n-dimensional problem and to the problem of N particles in one dimension interacting pairwise via a quadratic time dependent potential and a constant inversely quadratic potential, are finally sketched. Author (ESRO)

N72-13658# Rome Univ. (Italy). Inst. of Physics.
PION ELECTROPRODUCTION ON POLARIZED PROTONS NEAR THE SINGLE PION THRESHOLD AS A TEST OF T INVARIANCE
M. Balla and G. Marini 21 Jan. 1971 25 p refs
(Nota-Interna-303) Avail: NTIS

The study of single pion electroproduction on polarized nucleons, near threshold, is suggested as a significant test of invariance under T of the e.m. interaction of hadrons. The cross sections and the asymmetries for such a process are deduced and numerical evaluations of the effect are given. Author (ESRO)

N72-13659# Rome Univ. (Italy). Inst. of Physics.
PROJECT OF A LAMBDA(O) HYPERON MISSING MASS SPECTROMETER TO STUDY THE REACTION PION(MINUS) PLUS PROTON YIELDS LAMBDA(O) HYPERON PLUS NEUTRALS
I. Bruner, U. Dore, P. Guidoni, I. Laakso, G. Martellotti, G. Marini,

F. Massa, G. Piredda, and P. Pistilli 22 Jan. 1971 38 p refs
(Nota-Interna-304) Avail: NTIS

A counter spark chamber apparatus is described, for the investigation of the neutral missing mass spectrum in the reaction:negative pion + proton yields hyperon + neutrals, via the detection and measurement of the hyperons produced with small 4-momentum transfer. The physical interest in the exploration of the missing mass spectrum below 1.8 GeV/sq c, at incident negative pion momenta between approximately 5 and 10 GeV/c, is briefly outlined. Estimates of the foreseen neutral particle mass resolution, and the expected counting rates, are given. ESRO

N72-13660# Rome Univ. (Italy). Inst. of Physics.
NUCLEAR CORE RENORMALIZATION AND SCALING PROPERTIES OF SOME RESIDUAL INTERACTIONS
P. Camiz, A. D'Andrea, E. Olivieri, and M. Scalia 29 Mar. 1971 7 p ref Submitted for publication Sponsored in part by CNR
(Nota-Interna-307) Avail: NTIS

A model is presented for a renormalizing parameter, directly connected with the scalar polarization of a nuclear core upon the effect of valence nucleons. The model is based on the hypothesis that the modification experienced by the core when nucleons are added can be described by variations of the core radius. ESRO

N72-13661# Rome Univ. (Italy). Inst. of Physics.
EXACT GROUND STATE OF SOME ONE-DIMENSIONAL N-BODY SYSTEMS WITH INVERSE (COULOMB-LIKE) AND INVERSE-SQUARE (CENTRIFUGAL) PAIR POTENTIALS
F. Calogero and C. Marchioro 5 May 1971 9 p refs
(Nota-Interna-315) Avail: NTIS

The exact ground state and corresponding binding energy were calculated for a system composed of N, nonidentical, quantum mechanical particles interacting in one dimension via a pair potential of inverse Coulomb-like and inverse square, centrifugal, types. ESRO

N72-13662# Rome Univ. (Italy). Inst. of Physics.
MAGNITUDE OF THE SIGMA-TERM, CHIRAL SYMMETRY AND SCALE INVARIANCE
G. Altarelli, Cabibbo, and L. Maiani (Ist. Super. di Sanita) 18 May 1971 13 p refs
(Nota-Interna-317) Avail: NTIS

A hypothesis for the breaking of the SU(3) X SU(3) chiral symmetry is examined in the light of a recent computation of the sigma term in pion-neutron scattering. Other available information on this amplitude near the threshold is also used. The sigma term result is found to give further support to the hypothesis that the pion-neutron amplitude is very smooth in the soft pion region. A new sum rule is proposed among low energy parameters based on the smoothness hypothesis, and found to be well satisfied. The magnitude of the sigma term can be understood as the manifestation of an approximate scale symmetry, whose breaking is of the same order of magnitude as the breaking of SU(3) X SU(3). ESRO

N72-13663# Royal Inst. of Tech., Stockholm (Sweden). Div. of Electron Physics.
NEW SOURCES OF VERY HIGHLY CHARGED HEAVY IONS
J. E. Eninger Oct. 1971 31 p refs Submitted for publication
(TRITA-EPP-71-31) Avail: NTIS

The importance of high charge-to-mass ratios in the acceleration of heavy ions is discussed. The performance and limitations of existing heavy ion sources are briefly summarized. A review is given of new ion source concepts proposed for the production of very highly charged heavy ions. These concepts include electron beam sources, laser sources and some other high temperature plasma devices as well as the method of acceleration and stripping. The current status of the development work on the novel heavy ion sources are described. NSA

N72-13664# Army Foreign Science and Technology Center, Charlottesville, Va.
A NEW METHOD OF ACCELERATING NUCLEAR PARTICLES
Vladistav Pavlovich Sarantsev 20 Jul. 1971 19 p ref Transl. into ENGLISH of Russian report
(AD-728146; FSTC-HT-23-128-71; T7023012301) Avail: NTIS CSCL 20/7

A new principle of accelerating charged particles was proposed by V. I. Vekslu in 1956. This principle employs collective interactions and coherent effect (wherein instead of individual particles there is a packet of particles interacting as an integral whole; in this connection the field strength increase in proportion to the number of particles). During the last few years V. P. Sarantsev has been directing work on creating a reactor based on the new principle. The development and operation of the accelerator are discussed. Author (GRA)

N72-13665# Teledyne Isotopes, Westwood, N.J.
PROJECT STARDUST, VOLUME 3, CHAPTERS 9 TO 13 Final Report
Herbert W. Feely, James P. Friend, Harold Seitz, John D. Martin, and Woodland E. Erlebach 15 Mar. 1971 220 p refs
(Contract DA-49-146-XZ-079; ARPA Order 0172)
(AD-728412; IWL-0001-I43-Vol-3; DASA-2166-3-Vol-3) Avail: NTIS CSCL 18/8

Contents: The stratospheric transport of plutonium-238 from the April 1964 SNAP-9 burnup; Stratospheric distribution of cosmic ray activity; The distribution of lead-210 and polonium-210 in the stratosphere; Stratospheric meteorological processes, models and data from Project Stardust; The Stardust numerical model of transfer and rainout of stratospheric radioactive materials. Author (GRA)

N72-13666# Naval Postgraduate School, Monterey, Calif.
AN INVESTIGATION OF THE INFLUENCE OF SCALING LAWS ON THE RATIO OF NEUTRON-PROTON CHARGE FORM FACTOR CALCULATIONS M.S. Thesis
Joseph Homer Brooks and Gregg Frederick Sessler Jun. 1971 46 p refs
(AD-728576) Avail: NTIS CSCL 20/8

An investigation of conventional and broken-symmetry scaling, and their effect on the ratio of the neutron-proton electric form factors, G sub En/G sub Ep, was carried out using measurements from elastic electron-deuteron and electron-proton scattering in the range of momentum transfers, q squared, of 0.10 equal to or less than q squared equal to or less than 0.80 F(-2), and electron scattering angles from 45 to 120 deg. In this range of momentum transfers and angles, it was concluded that both forms of scaling as applied to the deuteron form factor have negligible effect on the ratio G sub En/ G sub Ep, and the application of either scaling law to the proton form factor results in nearly identical corrections to this ratio. Thus allowing no distinction between them, the agreement of the experimental data with the neutron-electron interaction slope at q squared is approximately 0 is not influenced by the choice of scaling law. A conclusive test for the scaling laws would require an improvement in experimental accuracy by at least an order of magnitude.
Author

N72-13667# Massachusetts Inst. of Tech., Cambridge. Research Lab. of Electronics.
[ELECTRONICS RESEARCH IN GENERAL AND PLASMA PHYSICS, AND COMMUNICATION SCIENCES] Quarterly Progress Report, period ending 31 May 1971
H. J. Zimmermann, G. G. Harvey, and S. J. Mason 15 Jul. 1971 218 p refs
(Contracts DA-28-043-AMC-02536(E); DA Proj. 200-61102-B-31F)
(AD-728303; QPR-102) Avail: NTIS CSCL 20/8

The document covers research in Information theory, Molecular physics, Radio astronomy, Acoustics, Plasma physics, Biophysics, Signal processing, and Physiology. GRA

N72-13668# Air Force Academy, Colo.
NEUTRON DOSE TRANSMISSION FACTORS THROUGH AN F-102 AIRCRAFT
Jerald N. Jensen and Joseph F. Janni May 1971 51 p refs
(AD-728198; USAFA-RR-71-5) Avail: NTIS CSCL 18/8

The authors measured dose transmission factors for the F-102 aircraft using a Pu-Be source neutron flux incident from several directions around the cockpit. Neutron dose measurements were made with an Eberline PRN-4 neutron dosimeter, while the gamma radiation induced by the neutron interactions in the aircraft was measured using a Geiger-Mueller tube. Transmission factors for cockpit exposure doses and body depth doses (approximated by using a paraffin shield) were measured and tabulated. The cockpit exposure dose transmission factors ranged from .36 to 1.17 with most values greater than .8. The depth dose transmission factors varied from .16 to .8 with most values near .5. Author (GRA)

N72-13669# Aerospace Corp., El Segundo, Calif. Lab. Operations.
DIFFERENTIAL AND INTEGRAL CROSS SECTIONS FOR THE ELECTRON IMPACT EXCITATION OF THE 2 SINGLET DELTA G AND D SINGLET SIGMA G PLUS STATES OF O2 Technical Report, Aug. 1970 - Mar. 1971
David C. Cartwright, Sandor Trajmar, and Walter Williams 1 Aug. 1971 48 p refs
(Contract F04701-71-C-0172)
(AD-729185; TR-0172(9260-01)-2; SAMSO-TR-71-151) Avail: NTIS CSCL 07/4

Electron impact energy-loss spectra of O2 have been analyzed for incident electron energies from 4 eV to 45 eV, scattering angles from 10 to 90 degrees, and for energy loss from 0 to 5 eV. The inelastic processes observed were the excitation of the a singlet Delta(g) and b singlet Sigma(g)(&) electronic states and vibrational excitation in some cases to $v'' = 13$. The excitation cross sections at each energy were made absolute by normalizing the sum of the integral cross sections (all inelastic, ionization and elastic) to measured electron-O2 total cross sections. The differential cross sections for the a singlet Delta(g) and b singlet Sigma(g)states show nearly isotropic behavior as expected for optically spin-forbidden transitions. The elastic differential cross sections are strongly forward peaked at higher energies but become only slightly forward peaked at the lower energies. Author (GRA)

N72-13943# Royal Swedish Academy of Engineering Sciences, Stockholm.
PARTICLES FASTER THAN LIGHT
In its Develop. in Res. and Technol. during 1970 1970 p 53-55 refs In SWEDISH (See N72-13942 04-34)
Avail: NTIS; Almqvist & Wiksell, Stockholm: 25 Kr

N72-13944# Royal Swedish Academy of Engineering Sciences, Stockholm.
NUCLEAR PHYSICS
In its Develop. in Res. and Technol. during 1970 1970 p 55-56 refs In SWEDISH (See N72-13942 04-34)
Avail: NTIS; Almqvist & Wiksell, Stockholm: 25 Kr

N72-13945# Royal Swedish Academy of Engineering Sciences, Stockholm.
HOW TO SEE AN ATOM
In its Develop. in Res. and Technol. during 1970 1970 p 56-59 refs In SWEDISH (See N72-13942 04-34)
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STUDIES OF FAST REACTIONS
In its Develop. in Res. and Technol. during 1970 1970 p 65-66 refs In SWEDISH (See N72-13942 04-34)
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25 PHYSICS, PLASMA

Includes magnetohydrodynamics. For applications see: 28 Propulsion Systems.

N72-13670 National Lending Library for Science and Technology, Boston Spa (England).
INVESTIGATIONS OF PLASMA CONFINEMENT AND HEATING IN THE TOKAMAK T-4 DEVICE
L. A. Artsimovich, V. A. Vershkov, A. V. Glukhov, E. P. Gorrunov, V. S. Zaveryaev, S. E. Lysenko, S. V. Mirnov, I. B. Semenov, and V. S. Strelkov 22 Sep. 1971 9 p refs Transl. into ENGLISH of I. V. Kurchatov Inst. of Atomic Energy, Moscow, Report CN-28/C-8 Presented at 4th Conf. on Plasma Phys. and Controlled Nucl. Fusion Res., Madison, Wis., 1971
(NLL-CTO-782-(9091.9F); CN-28/C-8) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

Experimental results are reported which were obtained with the Tokamak-4 apparatus, which has a higher stabilizing magnetic field (50 kOe) than the Tokamak-3a. The data reported concern the plasma energy balance and electron and ion heating. Electron temperature was measured by means of the absorption of soft X-radiation, and ion temperature by means of neutron emission intensity. The total energy content of the plasma column was found from the diamagnetic effect. Since the main results were obtained at a fairly high plasma density, it is suggested that the energy transfer from electrons to ions occurs principally by Coulomb binary collision. Based on this assumption, ion energy lifetime was determined from the steady state ion temperature. The experimental values for the ion temperature were compared with those calculated by the Galeyev-Sagdeyev neoclassical theory. Author

N72-13671 National Lending Library for Science and Technology, Boston Spa (England).
HELICAL MAGNETIC CONFIGURATIONS WITH MINIMUM B BAR
N. M. Zueva 22 Sep. 1971 20 p refs Transl. into ENGLISH from Russian report
(NLL-CTO-766-(9091.9F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 2 NLL photocopy coupons

Helical magnetic fields for plasma confinement are considered. One class of helical fields is examined and their structure elucidated. Fields having a magnetic well on the axis are analyzed in detail. Author

N72-13672 National Lending Library for Science and Technology, Boston Spa (England).
THE THEORY OF PLASMA CONFINEMENT IN A TOKAMAK AT HIGH TEMPERATURES
A. A. Galeev and R. Z. Sagdeev 22 Sep. 1971 19 p refs Transl. into ENGLISH of Acad. of Sci., High Temp. Inst., Moscow, report CN-28/C-11 Presented at 4th Conf. on Plasma Phys. and Controlled Nucl. Fusion Res., Madison, Wis., 1971
(NLL-CTO-774-(9091.9F); CN-28/C-11) Avail: Natl. Lending Library, Boston Spa, Engl.: 2 NLL photocopy coupons

Plasma dynamics in a Tokamak is considered for long free paths such that the particles may be classified as trapped or passing particles. The kinetic equilibrium of the plasma was analyzed. In determining the equilibrium configuration of the magnetic field, banana currents, similar to the Larmor current in a uniform magnetic field, are considered. Expressions are derived

for the diamagnetic signal and displacement of the plasma column. The dynamics of the column was evaluated on the basis of the heat and particle balance equations with neoclassical transport coefficients. A difference between neoclassical and experimental values for the transport coefficients in a dilute plasma was analyzed. Models are discussed which yield anomalous transport features due to low frequency turbulence of trapped and passing particles. Author

N72-13673# Tokyo Univ. (Japan). Inst. of Space and Aeronautical Science.

EQUILIBRIUM AND NONEQUILIBRIUM ELECTRICAL CONDUCTIVITY OF A POTASSIUM-SEEDED ARGON PLASMA

Fujihiko Sakao (Hiroshima Univ.) and Hiroshi Sato May 1971 47 p refs

(ISAS-462-Vol-36-No-4) Avail: NTIS

Experiments on the electrical conductivity of argon-potassium and helium-potassium plasmas at atmospheric pressure are described. Thermal ionization of the potassium atoms makes the gas electrically conductive. An electric current of short duration is passed through the ionized gas. The electric field in the plasma is determined as a function of current density. With low current density conductivity is independent of current density and the plasma is in thermal equilibrium. The average cross section of a potassium atom for electron-momentum transfer is estimated to be 2.3 x 10 to the -14th power sq cm. For intermediate current density, conductivity is lower than the equilibrium value. The decrease is interpreted on the basis of the non-Maxwellian distribution of electron energy and the decrease in electron mobility at high electron temperature. The apparent conductivity at high current density is large, but the current density in the plasma may not be uniform. Author

N72-13674*# Toronto Univ. (Ontario). Inst. for Aerospace Studies.

AN INVESTIGATION OF THE NORMAL MOMENTUM TRANSFER FOR GASES ON TUNGSTEN

E. J. Moskal Jun. 1971 129 p

(Grant NGR-52-026-001)

(NASA-CR-124694; UTIAS-166) Avail: NTIS CSCL 20I

The near monoenergetic beam of neutral helium and argon atoms impinged on a single crystal tungsten target, with the (100) face exposed to the beam. The target was mounted on a torsion balance. The rotation of this torsion balance was monitored by an optical lever, and this reading was converted to a measurement of the momentum exchange between the beam and the target. The tungsten target was flashed to a temperature in excess of 2000 C before every clean run, and the vacuum levels in the final chamber were typically between 0.5 and 1 ntorr. The momentum exchange for the helium-tungsten surface and the argon-tungsten surface combination was obtained over approximately a decade of incoming energy (for the argon gas) at angles of incidence of 0, 30, and 41 deg on both clean and dirty (gas covered) surfaces. The results exhibited a significant variation in momentum transfer between the data obtained for the clean and dirty surfaces. The values of normal momentum accommodation coefficient for the clean surface were found to be lower than the values previously reported. Author

N72-13675# Centre de Recherches en Physique des Plasmas, Lausanne (Switzerland).

STRUCTURE OF A PULSED NOZZLE FOR MOLECULAR HYDROGEN AND CONDENSED NITROGEN

R. Keller Oct. 1971 35 p refs In FRENCH; ENGLISH summary

(LRP-49/71) Avail: NTIS

High intensity molecular hydrogen beams and condensed nitrogen beams have been obtained using a cooled, pulsed Laval nozzle. The collimated beams, which have sharp profiles, are considered suitable for plasma injection experiments. Author

N72-13676# Nagoya Univ. (Japan). Inst. of Plasma Physics.

SOME OBSERVATIONS OF A LINEAR SCREW-PINCH DISCHARGE

Kiyoshi Hayase and Takayoshi Okuda Jul. 1971 26 p refs

(IPPJ-108) Avail: NTIS

Plasma properties in a linear screw-pinch discharge are investigated with emphasis on the problems of production and stability. This device is characterized with the half periods of both z-and theta-currents. The half periods of these currents are as long as 32 microns. Plasma behaviors are observed for different time intervals between starts of z- and theta-pinch discharge, and the preionization, the z-pinch discharge is necessary for the uniform and reproducible discharge. The electron temperature and density measured by laser scattering and interferometry are less than or approximately 10 eV and approximately 10 to the 16th power cu/cm, respectively, in a normal pressure region. The sudden collapse of the outer region of the plasma column near at the current maximum is observed at certain conditions and its reason and suppression are considered. The magnetohydrodynamic stability is also investigated, taking into account the distributed current, to explain the mode m = 2 which appears even within the Kruskal-Shafranov limit in the experiment. The effect of the superposition of the high frequency z-current is examined with a relation to the dynamic stabilization. Author

N72-13677# Nagoya Univ. (Japan). Inst. of Plasma Physics.

A BACK-DIFFUSION TYPE SOURCE OF MONOENERGETIC IONS

Tadao Honzawa Jul. 1971 16 p refs

(IPPJ-109) Avail: NTIS

The results of an experimental study on a new type ion source, which is very simple in construction and can be operated in any kind of gas at a pressure from 0.000001 to 0.01 torr, are described. The source can produce monoenergetic ions with a controllable energy from a few tens to several hundreds eV and with density up to several times 10 to the 7th power cu/cm. As ion beams produced thereby are neutralized by thermal electrons from cathodes, the rapid divergence of the beams during runs hardly occurs. Author

N72-13678*# Pennsylvania State Univ., University Park. Dept. of Aerospace Engineering.

AN INVESTIGATION OF TRANSIENT PRESSURE AND PLASMA PROPERTIES IN A PINCHED PLASMA COLUMN M.S. Thesis

E. K. Stover and T. M. York Sep. 1971 99 p refs

(Grant NGL-39-009-015)

(NASA-CR-124737; PSU-AERSP-71-4) Avail: NTIS CSCL 20I

The transient pinched plasma column generated in a linear Z-pinch was studied experimentally and analytically. The plasma column was investigated experimentally with the following plasma diagnostics: a special rapid response pressure transducer, a magnetic field probe, a voltage probe and discharge luminosity. Axial pressure profiles on the discharge chamber axis were used to identify three characteristic regions of plasma column behavior; they were in temporal sequence: strong axial pressure asymmetry noted early in plasma column lifetime followed by plasma heating in which there is a rapid rise in static pressure and a slight decrease static pressure before plasma column breakup. Plasma column lifetime was approximately 5 microseconds. The axial pressure asymmetry was attributed to nonsimultaneous pinching of the imploding current sheet along the discharge chamber axis. The rapid heating is attributed in part to viscous effects introduced by radial gradients in the axial streaming velocity. Turbulent heating arising from discharge current excitation of the ion acoustic wave instability is also considered a possible heating mechanism. Author

N72-13679*# California Univ., Los Angeles.

TURBULENT RESISTIVITY, DIFFUSION, AND HEATING

Burton D. Fried, Charles F. Kennel, Kenneth Mackenzie, Ferdinand V. Coroniti, Joseph M. Kindel, R. Stenzel, Robert J. Taylor,

Roscoe White, Alfred Y. Wong, William Bernstein et al 17 Jun. 1971 8 p refs Presented at the 4th Conf. on Plasma Phys. and Controlled Nucl. Fusion Res., Madison, Wis., 17-20 Jun. 1971 Sponsored in part by NASA, AEC, ONR, AFOSR, NSF, and TRW Independent Research Program
(NASA-CR-124794; CN-28/E-4; Conf-710607-52) Avail: NTIS CSCL 20I

Current flow with density j >(N sub e)(c sub s) encounters resistance due to ion acoustic turbulence when T sub e >> T sub i. Experiments were conducted with a streaming cesium plasma, and electron current, potential rise due to turbulent resistivity, the spectrum of unstable ion acoustic waves, and associated electron heating were measured. When ion acoustic turbulence is present (T sub e/T sub i > 5), experiments with double plasma devices show rapid anomalous heating of an ion beam streaming through a plasma. These devices also produce large-amplitude collisionless ion acoustic shocks, both laminar and turbulent. At low Mach numbers, a beam of reflected ions is observed. Turbulence, either natural or triggered by fluctuations of injected ion waves, scatters the reflected ions and heats the shocked ions. A few percent He in an A plasma can significantly change both shock amplitude and laminar/turbulent transition. At higher density ratios, the Mach number increases (maximum observed about 1.8) and the structure washes out. Author

N72-13680*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
THREE DIMENSIONAL POTENTIAL AND CURRENT DISTRIBUTIONS IN A HALL GENERATOR WITH ASSUMED VELOCITY PROFILES
N. Stankiewicz and R. W. Palmer Washington Jan. 1972 33 p refs
(NASA-TN-D-6622; E-6551) Avail: NTIS CSCL 20I

Three-dimensional potential and current distributions in a Faraday segmented MHD generator operating in the Hall mode are computed. Constant conductivity and a Hall parameter of 1.0 is assumed. The electric fields and currents are assumed to be coperiodic with the electrode structure. The flow is assumed to be fully developed and a family of power-law velocity profiles, ranging from parabolic to turbulent, is used to show the effect of the fullness of the velocity profile. Calculation of the square of the current density shows that nonequilibrium heating is not likely to occur along the boundaries. This seems to discount the idea that the generator insulating walls are regions of high conductivity and are therefore responsible for boundary-layer shorting, unless the shorting is a surface phenomenon on the insulating material. Author

N72-13681# Joint Publications Research Service, Washington, D.C.
AMPLIFICATION IN A DECAYING PLASMA
L. I. Gudzenko and L. A. Shelepin 22 Dec. 1971 7 p refs Transl. into ENGLISH from Magnitn. Gidrodinam., Akad. Nauk Latv. SSR (Riga), no. 3, Jul.-Sep. 1965 p 57-60
(JPRS-54769; UDC-533.9.01:621.378.1) Avail: NTIS

The properties of nonequilibrium plasma which amplifies electromagnetic radiation at its discrete spectrum frequencies are discussed. Three decay stages of nonequilibrium plasma, corresponding to various degrees of ionization, are analyzed qualitatively. It is postulated that the ionization of the plasma is substantially higher than the equilibrium value corresponding to the average energy of its free electrons. Author

N72-13682*# Scientific Translation Service, Santa Barbara, Calif.
INVESTIGATION OF PLASMA DRIFT AND EQUILIBRIUM IN TOROIDAL MAGNETIC FIELD WITH DIVERTOR
V. G. Zykov, V. I. Karpukhin, N. I. Rudvev, and V. T. Tolok Washington NASA Dec. 1971 11 p refs Transl. into ENGLISH from Ukr. Fiz. Zh. (Ukrainia SSR), v. 16, no. 2, Feb. 1971 p 303-308
(Contract NASw-2035)
(NASA-TT-F-14087) Avail: NTIS CSCL 20I

Experiments conducted with Sirius stellarator diverter showed that the diverter magnetic field ensures stability of the plasma inside this surface and equilibrium of the plasma in the toroidal magnetic field. Author

N72-13683*# Maryland Univ., College Park. Dept. of Physics and Astronomy.
SPECTROSCOPIC INVESTIGATION OF ELECTRIC FIELD FLUCTUATIONS IN A STEADY PLASMA
Michel P. Druetta May 1971 20 p refs Sponsored in part by NASA and ESRO
(NASA-CR-124673) Avail: NTIS CSCL 20I

The electric fluctuations caused by plasma oscillations of a steady plasma were investigated. In order to observe this phenomenon electric field fluctuations are created in a helium plasma by an electron beam. Spectroscopic analysis reveals satellite lines disposed symmetrically in pairs about a forbidden atomic line and separated from it by the frequency of the electric field oscillations. ESRO

N72-13684# California Univ., Berkeley. Lawrence Radiation Lab.
END REGIONS IN THE STEADY STATE OF MIRROR-CONFINED PLASMAS Ph.D. Thesis
John U. Guillory, Jr. 24 Feb. 1971 207 p refs
(Contract W-7405-eng-48)
(UCRL-20615) Avail: NTIS

Realistic models for the ion and electron distribution functions in the confinement region are used to estimate the external density and external plasma potential. It is found that this density is usually sufficient for plasma in the external region. The external ion density due to losses from the confinement region depends on the scattering rate (Coulomb or other scattering) in a simple way, through the flux of escaping ions and the width of the tail of the ion distribution function. There is, in general, a plasma sheath at the vessel wall. The external density may be enhanced by production of plasma near the walls or by electron emission from the walls, but two-stream instability sets in at some critical production rate. In the presence of such an external source, the plasma reaches a new steady state, which is described for the stable and the unstable case. It is shown that the plasma density cannot ordinarily increase outward from the mirrors. Author (NSA)

N72-13685# Stanford Univ., Calif. Inst. for Plasma Research.
STUDIES OF PLASMA OSCILLATIONS Final Report, 1 Dec. 1959 - 31 Jan. 1971. Semiannual Report, 1 Aug. 1970 - 31 Jan. 1971. Status Report No. 37
Feb. 1971 44 p refs
(Contract AT(04-3)-799)
(SU-IPR-411; Task-A) Avail: NTIS

The basic hot cathode positive column discharge was examined by a number of techniques to pinpoint the sources of oscillations and instabilities in it and to determine their excitation mechanisms. Specific phenomena, such as beam/plasma interaction and ion acoustic wave propagation, were studied by probing suitable plasmas with externally applied signals, and attempts were made, by analysis and measurement, to reduce the discrepancies between theory and experiment. Finally, a wide variety of plasma wave and instability phenomena were examined in detail. The research program, bibliography of reports, conference papers, and publications prepared under the contract, are listed. Author (NSA)

N72-13686# Addis Translations International, Woodside, Calif.
METHODS AND SYSTEMS OF BEAM INDICATION IN THE STORAGE RING AT THE ENGINEERING PHYSICS INSTITUTE OF THE ACADEMY OF SCIENCES OF THE UKRAINIAN SSR
N. I. Mocheshnikov and L. V. Reprintsev Berkeley, Calif. Lawrence Radiation Lab. Feb. 1971 14 p refs Transl. into ENGLISH of Akad. Nauk Ukr. SSR, Fiziko-Tekhnicheskii Inst.,

Kharkov, Report KHFTI-70-44 In ENGLISH and RUSSIAN Prepared for Calif. Univ., Berkeley, Lawrence Radiation Lab.
(UCRL-Trans-1438; KHFTI-70-44) Avail: NTIS

Instruments for measuring the parameters of the injected beams, measuring the characteristics of the stored beam from its synchrotron radiation, and studying the harmonic makeup of the stored beam at the N-100 storage ring are described. NSA

N72-13687# Stichting voor Fundamenteel Onderzoek der Materie, Jutphaas (Netherlands). Inst. voor Plasma-Fysica.
PLASMA FORMATION, HEATING, AND STABILITY IN A CUSPED MAGNETIC FIELD BY INJECTION OF A 20 KEV HYDROGEN ION BEAM
H. DeKluiver, A. L. Nijsen-Vis, W. Huizenga, B. Brandt, T. C. VanderHeiden, and W. Schuurman Dec. 1970 88 p refs Sponsored by EURATOM and Ned. Organisatie voor Zuiver-Wetenschap. Onderzoek.
(NP-18939; Rept-70-63) Avail: AEC Depository Libraries

After the formation of the primary plasma, a secondary plasma is built up by ionization and charge exchange processes. Plasma density was determined as a function of injected current, gas pressure, and magnetic field strength. The energies and electron temperature of the different plasma species were determined. A positive plasma potential of about 50 volt is established by the injection. Rotation of the plasma as well as rotating fluctuations were detected during injection and in the afterglow. Oscillation patterns during injection can roughly be distinguished into two groups with frequencies near 10 and 200 kHz. The heating of the secondary plasma by the beam is manifested by the presence of wide RF noise bands between the electron plasma frequency and the ion cyclotron frequency. A plasma model based on quasi neutrality and the differences in loss rates of H(+), H2(+), and electrons leads to a positive plasma potential and explains the obtained density. The calculated ratio of five between plasma potential and electron temperature is in close agreement with the experiment. Author (NSA)

N72-13688# California Univ., Berkeley. Lawrence Radiation Lab.
MULTIPLE SCATTERING OF ELECTROMAGNETIC WAVES IN AN UNDERDENSE PLASMA AND THE RADIATION TRANSPORT EQUATION
Chau-wa Lau 29 Apr. 1971 51 p refs
(Contract W-7405-eng-48)
(UCRL-20689) Avail: NTIS

The multiple scattering of electromagnetic waves in an underdense turbulent plasma is studied. Using familiar diagrammatic techniques, integral equations were derived for the coherent wave and radiation flux. On the basis of these integral equations, the conditions under which coherent propagation can be described by a refractive index are examined; incoherent scatterings of the radiation flux can be described by the conventional radiation transport equation. Expressions are given relating the absorption coefficient and scattering function in the transport equation to the electron density fluctuations.
Author (NSA)

N72-13689# Princeton Univ., N.J. Plasma Physics Lab.
NONLINEAR THEORY FOR PLASMA DRIVEN BY A LARGE-AMPLITUDE, HIGH FREQUENCY FIELD. 1: GENERAL THEORY, LINEAR, AND QUASILINEAR EVOLUTION
E. J. Valeo and C. Oberman Mar. 1971 52 p refs
(Contract AT(30-1)-1238)
(MATT-835) Avail: NTIS

By means of an asymptotic multiple-time-scale technique, equations capable of describing the nonlinear evolution of a parametrically driven homogeneous plasma are developed. The small expansion parameter is the electron-to-ion mass ratio. A general expression for the nonlinear (in both the pump and fluctuation intensities), high-frequency energy absorption rate is derived as a function of the fluctuation amplitudes which may be computed nonlinearly within the framework of the theory. The linearized form of these equations is compared with the results of others. A novel consequence of the linearized theory is the prediction of a definite phase relation between the self-consistent high-frequency waves and the pump wave, which necessitates a modification of the random-phase approximation of usual weak turbulence theory. Author (NSA)

N72-13690# Oak Ridge National Lab., Tenn. Thermonuclear Div.
ELECTROSTATIC INSTABILITIES DRIVEN BY CURRENTS PERPENDICULAR TO AN EXTERNAL MAGNETIC FIELD
A. Hirose (Saskatchewan Univ.) and I. Alexeff Jun. 1971 37 p refs
(Contract W-7405-eng-26)
(ORNL-TM-3532) Avail: NTIS

High frequency electrostatic instabilities driven by an electron-ion relative drift velocity across an external magnetic field are discussed for an inhomogeneous plasma. The presence of a density gradient perpendicular to the magnetic field was found to greatly reduce critical velocities for the onset of several instabilities such as lower hybrid oscillations and ion cyclotron harmonic waves. It was also found that the lower hybrid instability can be caused by some positive dissipation mechanism such as Landau damping due to thermal ions and a finite electron collision rate. Some applications were made to turbulent heating experiments in plasmas in which cross-field currents are present.

N72-13691# Royal Inst. of Tech., Stockholm (Sweden). Div. of Plasma Physics.
REVERSE DEFLECTION AND CONTRACTION OF A PLASMA BEAM MOVING ALONG CURVED MAGNETIC FIELD LINES
L. Lindberg and L. Kristoferson Jun. 1971 12 p refs
(TRITA-EPP-71-13) Avail: NTIS

A plasma beam which originally moves in a longitudinal magnetic field and enters a region of curved magnetic field is investigated experimentally. It is found that the beam contracts perpendicular to the vxB-direction and the whole beam becomes deflected in the direction opposite to that in which the magnetic field is curved. The deflection is caused by propagation backwards of the transverse electric field which is induced when the beam enters the region with curved field. Author (ESRO)

N72-13692# Royal Inst. of Tech., Stockholm (Sweden). Div. of Plasma Physics.
ACCELERATION OF AURORAL PARTICLES BY ELECTRIC DOUBLE LAYERS
Lars P. Block Sep. 1971 26 p refs Presented at the 9th ESRO Summer School on Earth's Particles and Fields, Cortina, Italy, 30 Aug. - 10 Sep. 1971
(TRITA-EPP-71-16) Avail: NTIS

Recent observations of precipitating particles and motions of auroral forms indicate that auroral particles are accelerated by electric fields directed along the magnetic field observed. It is argued that large field aligned potential drops should sometimes be concentrated in thin double layers (sheaths). Properties and consequences of such sheaths are reviewed and compared with evidence from several rocket and satellite observations. It is pointed out that parallel electric fields due to anomalous resistivity may not produce secondary energy distribution peaks, nearly monoenergetic precipitation, and anisotropies, since anomalous resistivity is due to scattering processes that should wipe out such peaks. It seems more likely that the acceleration occurs in sheaths, and the velocity distributions are then smoothed out by instabilities. Author (ESRO)

N72-13693# European Space Research Inst., Frascati (Italy).
OBSERVATION OF A HIGH FREQUENCY ELECTROSTATIC WAVE INSTABILITY
T. A. Hall 1971 20 p refs Submitted for publication
Avail: NTIS

Observations are reported of an electron beam induced

instability in a warm low density magnetoplasma at frequencies less than the electron cyclotron frequency. The plasma modes are quasi-electrostatic and the strongest excitation mechanism is a resonant interaction with the slow electron beam mode. Measurement of the standing wave pattern shows, however, that the slowest plasma wave observed still has a phase velocity 30% higher than the electron velocity, thus making interaction with the slow beam wave impossible under normal circumstances. It is shown, however, that it is possible for the electron beam to produce an appreciable plasma flow in the opposite direction, resulting in a Doppler shift of the resonant frequency.
Author (ESRO)

N72-13694# European Space Research Inst., Frascati (Italy).
INSTABILITY OF TWO-DIMENSIONAL COLLISIONLESS PLASMAS WITH NEUTRAL POINTS
D. Biskamp (Inst. fur Plasmaphysik G.m.b.H.) and K. Schindler Jan. 1971 32 p refs
(ESRIN-IN-119) Avail: NTIS

Some general stability criteria are derived for situations where a typical electron Larmor radius (away from the neutral points) is much smaller than the characteristic length of the magnetic field. As an example, a sheet pinch with a periodic structure is discussed. It is found that the mode corresponding to coalescence of two neighboring pinches is unstable, and the growth rate gamma is estimated. Gamma turns out to be larger than the growth rate for the tearing mode of a plane sheet. Some remarks concerning single particle acceleration are added.
Author (ESRO)

N72-13695# Naval Postgraduate School, Monterey, Calif.
SELF-GENERATED MAGNETIC FIELDS PRODUCED BY LASER BOMBARDMENT OF A SOLID TARGET M.S. Thesis
Larry Joe Davis Jun. 1971 72 p refs
(AFOSR-MIPR-0004-69)
(AD-728633) Avail: NTIS CSCL 20/9

To investigate the phenomena associated with the production of dense plasmas through solid target bombardment by focused laser radiation, procedures relevant to assembly and operation of a high power giant pulse laser system, laser monitoring techniques, and the experimental arrangement for investigating the properties of a freely expanding plasma were developed. Using magnetic coil probes in the vicinity of the expanding laser-created plasma, signals were detected which indicated the presence of azimuthal magnetic fields. The magnitudes of the observed magnetic fields were as high as 35 Gauss. The dependencies of the self-generated magnetic fields (SGMF) upon background gas pressure, probe position, and applied external fields were investigated. A discussion of possible generation mechanisms in light of the experimental evidence is included.
Author (GRA)

N72-13696# Aerospace Corp., El Segundo, Calif. Lab. Operations.
TEMPERATURE PROFILES IN ARGON INDUCTION PLASMA: THEORY AND EXPERIMENT Technical Report, Aug. 1970 - Jan. 1971
Hans U. Eckert and David C. Pridmore-Brown Aug. 1971 26 p refs
(Contract F04701-71-C-0172)
(AD-728634; TR-0172(2220-01)-3; SAMSO-TR-71-142) Avail: NTIS CSCL 20/9

A comparison is made between recent temperature measurements of argon induction plasmas that include cases of annular geometry and calculations based on the one-dimensional Eiengaas-Heller equation. Exact numerical solutions, as well as approximate closed-form solutions derived from a two-zone model are used. Good agreement is obtained for the central portion of the plasma column with the exact method used for all reported power inputs and with the approximate method used for medium power input. Near the walls, however, the experimental temperatures are considerably higher for all geometries and power inputs. It is argued that here electron diffusion causes an overpopulation of electrons and thus an overestimation of gas temperatures when Saha equilibrium is assumed.
Author (GRA)

N72-13697# Naval Postgraduate School, Monterey, Calif.
INVESTIGATION OF A LOW DENSITY PLASMA UTILIZING LASER LIGHT SCATTERING M.S. Thesis
Charles John Koeber Jun. 1971 43 p refs
(AD-728585) Avail: NTIS CSCL 20/9

Measurement of plasma density and temperature was attempted using the technique of scattering laser light from the plasma and comparing the magnitudes of the scattered and input intensities. Although no significant results were obtained, a scattered signal was apparently obtained using a giant pulse laser. Both PIN photodiodes and photomultiplier tubes were used as detectors, and comparison showed the photomultipliers were more suitable. The most important results were modification of the laser to operate with a Pockels cell in a 'Q'-switched mode, improvement of the optical alignment system, and use of a light trap to eliminate internal reflected signals.
Author (GRA)

N72-13698# Army Foreign Science and Technology Center, Charlottesville, Va.
STUDY OF A MODEL OF AN MHD GENERATOR USING AN ARGON POTASSIUM PLASMA
N. M. Maslennikov and V. N. Germanyuk 21 Jul. 1971 16 p refs Transl. into ENGLISH from the monograph Issledovanie Modeli MGD-Generatora na Argono-Kalievoi Plazme, Magnitogid-rodinamicheskii Metod Poluchenlya Elektroenergii (USSR)
(AD-728591; FSTC-HT-23-785-71) Avail: NTIS CSCL 10/2

The electrical conductivity of an argon-potassium plasma is measured in an induced electric field with a static gas temperature of 1300-1500K, pressure in the stream 0.04 atm. The currents flowing between electrodes were studied, as well as the cathode and anode voltage drop on potassium-activated electrodes. During optical measurements, the influence of the plasmotron arc on the spectrum and electrical conductivity of the plasma was studied.
Author (GRA)

N72-13699# Naval Postgraduate School, Monterey, Calif.
CREATION AND MODIFICATION OF ACOUSTIC SIGNALS BY DISCHARGE PLASMA Ph.D. Thesis
Richard Willis Tripp, Jr. Jun. 1971 170 p refs
(AD-728583) Avail: NTIS CSCL 20/9

Sound production and modification in an Argon discharge plasma was investigated theoretically and experimentally. Sound production by ions in the cathode region was shown to be feasible and consistent with earlier experimental results. A numerical analysis of the theoretical dispersion relation of Ingard and Schulz showed that plasma amplification effects will not compensate for acoustic losses. The theory of the mobility-limited thermionic diode operated as a microphone was expanded. Such microphones were used in an experimental investigation of sound production and modification by a discharge plasma. Possible plasma effects on sound propagation were observed. The characteristics of sound production by the plasma were found to be in reasonable agreement with theory. A departure from theory at low frequencies was interpreted as arising from the effects of particle diffusion, an effect not previously observed in acoustics.
Author (GRA)

N72-13700# Polytechnic Inst. of Brooklyn, Farmingdale, N.Y. Dept. of Aerospace Engineering and Applied Mechanics.
EFFECT OF MICROWAVE RADIATION ON A SHOCK PRODUCED ELECTRON PRECURSOR
Samuel Lederman and Edward F. Dawson May 1971 27 p refs
(Contract DAHC04-69-C-0077; ARPA Order 1442)
(AD-728163; PIBAL-71-13; Program-Code-9E30) Avail: NTIS CSCL 20/9

The paper presents some results of experiments in which a

small pressure driven shock tube was used to produce shocks in Argon above Mach 10. This was strong enough to produce low level precursor ionization ahead of the shock. At the same time, the shock tube was used as a waveguide for pulsed X-Band microwave radiation with a peak power of a few kilowatts. This further ionized the gas in the precursor region, resulting in an ionization wave which propagated very rapidly toward the microwave source. The velocity of this wave was measured as a function of the microwave power and an interpretation and comparison with other data is given. Author (GRA)

N72-13701# Naval Postgraduate School, Monterey, Calif.
INVESTIGATION OF THETA-PINCH PRODUCED SHOCK WAVES IN A PLASMA M.S. Thesis
Charles Leslie Christensen Jun. 1971 59 p refs
(AD-728571) Avail: NTIS CSCL 20/9

The report discusses the completion and operational testing of the theta pinch experiment at the Naval Postgraduate School Plasma Facility. The system consists of a 42 micro F capacitor bank feeding a single turn theta pinch coil with a total energy capacity of 13.1 kJ. Included is a brief discussion of the theory of shock wave generation and propagation in a plasma along with experimental verification of reproducible hydrodynamic shock waves of Mach about 16 produced in a neutral Argon gas at 0.1 torr. Calculations based on the theory of shock wave thicknesses (3 cm.) are compared to observed values (10 cm.) at this pressure. An outline of proposed future experiments at the Plasma Facility is included in the recommendations.
Author (GRA)

N72-13702# Naval Postgraduate School, Monterey, Calif.
EFFECTS OF AN ACOUSTIC WAVE IN THE POSITIVE COLUMN OF A GLOW DISCHARGE M.S. Thesis
John Thomas Gilmartin Jun. 1971 57 p refs
(AD-728672) Avail: NTIS CSCL 20/9

An alternating current produced by an acoustic wave in the positive column region of a glow discharge in nitrogen gas under dc cofditions was measured using a magnetic probe in the form of a Rogowsky Ring. The electrodynamic speaker which generated the acoustic wave was calibrated in nitrogen gas in terms of acoustic pressure for frequencies from 50 Hz to 250 Hz at ambient pressures corresponding to glow discharge pressures through the use of a specially constructed mobility-limited thermionic diode. The frequency of the perturbation current was found to be the same as the frequency of the acoustic wave and its magnitude was a function of ambient pressure, dc discharge current, acoustic pressure, and acoustic frequency.
Author (GRA)

N72-13703# Stanford Univ., Calif. Dept. of Aeronautics and Astronautics.
TRANSPORT COEFFICIENTS OF HIGH PRESSURE ARGON IN A MAGNETIC FIELD Final Technical Report, 20 Oct. 1969 - 19 Oct. 1970
Ralph S. Devoto Wright-Patterson AFB, Ohio ARL Apr. 1971 114 p refs
(Contract F33615-70-C-1150; AF Proj. 7063)
(AD-728678; ARL-71-0075; DOD-Element-61102F; DOD-Sub-element-681307) Avail: NTIS CSCL 20/9

The thermal and electrical conductivity of ionized argon in chemical equilibrium has been computed for temperatures from 3000 - 25000 degrees K at pressures from 0.001 - 1000 atm. Values are given here for these properties with and without an imposed DC magnetic field up to 200k Gauss. A comparison is made of the computed properties with measurements in the wall-stabilized arc. Author (GRA)

N72-13704# Illinois Univ., Urbana. Gaseous Electronics Lab.
STUDIES OF LOW DENSITY PLASMAS WITH GAS LASERS Final Report
J. T. Verdeyen and B. E. Cherrington May 1971 18 p refs
(Contract AF 33(615)-5248; AF Proj. 7073)
(AD-729200; ARL-71-0078; DOD-Element-61102F; DOD-Sub-element-681301) Avail: NTIS CSCL 20/9

Studies of low density plasmas with gas lasers are summarized. Techniques were developed for diagnostics of medium density plasmas, of gas discharges capable of lasing, and of excited state species in gas discharges. Author (GRA)

N72-13705# Naval Research Lab., Washington, D.C.
COMPUTATIONS ON RELATIVISTIC ELECTRON BEAMS AND RINGS Interim Report
Jay P. Boris and Roswell Lee Jun. 1971 46 p refs
(AD-728994; NRL-MR-2284; NRL-77H02-26; DASA-Subtask-LA-0013) Avail: NTIS CSCL 20/9

Numerical calculations of relativistic electron-beam phenomena are being performed at NRL to complement the experimental and theoretical investigations taking place there. The major advantage of computational techniques over other methods is the ability of the researcher to probe regimes not accessible experimentally, either because of cost or technology, and intractible analytically. A two-dimensional (r, z cylindrical) plasma-simulation code, CYLRAD, is being used in these investigations. In this code the relativistic trajectories of individual particles are integrated forward in time using the fully retarded self-consistent electromagnetic field of the entire collection of particles. CYLRAD has been used to study the expansion of non-neutral homogeneous beams with and without externally applied guide magnetic fields and the results agreed well with theory. These calculations are presently being extended to the treatment of partially and fully neutralized inhomogeneous beams where the onset of backstreaming will be studied. CYLRAD is also being applied to electron-ring configurations in support of the joint electron-ring-accelerator experiment currently under construction at the University of Maryland. In these latter calculations the collapse of an electron ring equilibrium due to ion loading is being investigated. In the presence of realistic transverse energy spread in the ring, calculations have shown that the pinching is accompanied by oscillations about the time dependent equilibrium and evaporation of thermally energetic electrons from the surface of the contracting ring.
Author (GRA)

N72-13706# Army Foreign Science and Technology Center, Charlottesville, Va.
CHARACTERISTICS OF A PLASMATRON WITH POROUS ANODE COOLING
V. N. Yarygin 28 Jul. 1971 12 p refs Transl. into ENGLISH from Zh. Prikl. Mekh. Tekh. Fiz. (USSR), no. 2, 1968 p 72-76
(AD-729221; FSTC-HT-23-826-71; T702301-2301) Avail: NTIS CSCL 20/9

Experimental studies were performed of the effect of porous anode cooling on the thermal and volt-ampere characteristics of a single-chamber plasmatron with vortex stabilization of the arc in the 0.1-1 atm. pressure range. High efficiency and low flow contamination were achieved. Author (GRA)

26 PHYSICS, SOLID-STATE

Includes semiconductor theory; and superconductivity. For applications see: 16 Masers. For related information see also: 10 Electronics.

N72-13707 National Lending Library for Science and Technology, Boston Spa (England).
DIELECTRIC LOSS OF POLYMERS AT 75 GHz
E. Amrheim and H. W. Schulse [1971] 3 p Transl. into ENGLISH from Kolloid-Z. Z. Polymere (Darmstadt), v. 241, 1970 p 1034-1037
(NLL-M-20800-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

Partially crystalline substances were examined with respect

to their dielectric behavior. The region of multiple phonon absorption, situated between high frequency and infrared, produces the major loss occurring in the broad, low frequency end of the infrared absorption region. Temperature-dependent measurements yield information about the order of the absorption processes and the frequency of the phonons taking part. The measuring apparatus used is described. Author

N72-13708# Electrotechnical Lab., Tokyo (Japan).
ELECTRON SPIN RESONANCE STUDY IN STRONTIUM TITANATE
Hiromi Unoki Nov. 1970 61 p refs In JAPANESE, ENGLISH summary
(RR-710) Avail: NTIS

Strontium titanate (SrTiO3) crystal of perovskite structure was studied by means of electron spin resonance (ESR) and dielectric measurement over the temperature range from 300K to 4K. Electric field effect of ESR spectra was successfully observed at the lower temperature range where the dielectric permittivity was high. The ESR spectra of Fe(3+) at Ti site have exhibited a temperature dependent splitting which enabled us to determine the multiple cell structure below 110K as to be space group I 4/mcm. The rotation angle of oxygen-octahedra as the order parameter of the second order phase transition was accurately measured as function of temperature. Electric field effect of Gd(3+) at Sr site has exhibited a temperature- and field-dependent splitting which was observed only below 65K. The electric field induced spin Hamiltonian terms were determined as functions of temperature and with respect to orientation of the field to crystallographic axes. The results were analyzed in comparison with dielectric polarization characteristics of this crystal. The dielectric permittivity tensors at the lower temperature phases were determined for crystals in which multiple-domains were converted into a single domain by application of a uniaxial compressive stress. Author

N72-13709# Electrotechnical Lab., Tokyo (Japan).
PROPERTIES OF SEMICONDURTORS DOPED WITH DEEP-LEVEL IMPURITIES
Yoszo Tokumarv Dec. 1970 90 p refs In JAPANESE; ENGLISH summary
(RR-711) Avail: NTIS

Low-frequency current oscillations in high-resistivity, oxygen-doped GaAs are due to the periodic generation of a traveling high-field domain and are associated with trapping of electrons at deep levels. A model of bulk negative resistance effect based on the preferential capture of upper-valley electrons by deep levels is proposed. The negative resistance due to double injection is described. Diodes of p(+)-n(-)-n(+) structure fabricated from Cu-diffused Ge exhibit a current-controlled negative resistance region in the forward IV characteristics, ascribable to double injection of electrons and holes. Ionization energies of Ni in Si were measured: Ni has acceptor levels in the forbidden band of Si at 0.35 eV from the conduction band and at 0.23 eV from the valence band. Deep levels in GaAs were investigated by measuring the spectral response of photocurrent and the temperature dependence of resistivity. The precipitation of Ni in Si was studied by measuring resistivity of Ni-diffused Si after annealing and by observing the specimens with an infrared microscope. Lattice imperfections in Si induced by Pt diffusion are also described. Author

N72-13710# Technische Univ., Berlin (West Germany).
CONTRIBUTION TO THE GEOMETRICAL DERIVATION OF DOUBLE LAYER GRID STRUCTURES FROM THE CUBIC LATTICE Ph.D. Thesis
Helmut Eberlein 1970 110 p refs In GERMAN
Avail: NTIS

A systematic projection of all double layer grid structures derived from the cubic lattice is presented that includes simple cubic, face centered cubic, and body centered cubic forms. Polyhedral compounds in face centered nets are used to develop basic grids which are the results of two parallel sections through neighboring planar nets of space families. These basic grids are subdivided in 4 main groups, so that each receives the corresponding symmetry properties of the hexahedral 3 basic grid. Transl. by G.G.

N72-13711# Technische Univ., Berlin (West Germany).
CATHODE REFLECTION MECHANISM ON GERMANIUM Ph.D. Thesis
Rolf-Alexander Hoffmann 1970 91 p refs In GERMAN
(D-83) Avail: NTIS

The band structure of solid germanium is studied by modulation of the optical reflection through pulsed electron bombardment in the spectral region of the spin-decoupled E sub 1 transfer at low temperatures. Two modulation mechanisms, independent of each other, are observed: a thermal reflection component without participation of excitons, and an electronic reflection component. The time constant of the electronic reflection from differently doped crystals of about a few microseconds is an indication that the recombination of electron hole pairs is determined by Auger processes. It is concluded that reflections at the E sub 1 transfer level prove that only thermal and electronic reflections contribute substantially to the cathode response. Transl. by G.G.

N72-13712# Eidgenossische Technische Hochschule, Zurich (Switzerland).
CRYSTALLIZATION POTENTIALS IN AQUEOUS SOLUTIONS Ph.D. Thesis
Hermann Wiederkehr 1970 123 p refs In SWEDISH
(Diss-4563) Avail: NTIS

The dependence of crystallization potentials on crystal growth kinetics is studied on single crystals of KBr, KCl, NaCl, KNa-tartrate, and KH2PO4. Results show that the potential for all crystals is a direct function of growth velocity and that reproducible observations are only obtainable on crystal lamina with well defined level surfaces. Experiments on KBr single crystals prove that during dissolving conditions the potential increases towards the positive and decreases towards the negative during growing conditions. Transl. by G.G.

N72-13713# National Bureau of Standards, Washington, D.C. Inst. for Materials Research.
STANDARD X-RAY DIFFRACTION POWDER PATTERNS. SECTION 9: DATA FOR 63 SUBSTANCES
Howard E. Swanson, Howard F. McMurdie, Marlene C. C. Morris, Eloise H. Evans, and Boris Paretzkin Dec. 1971 129 p refs
(NBS-Mono-25-Sect-9; LC-53-61386) Avail: SOD $1.25 Catalog no. C13.44:25/Sec. 9

Standard X-ray diffraction patterns are presented for 63 substances. Forty of these patterns represent experimental data and 23 are calculated. The experimental X-ray powder diffraction patterns were obtained with an X-ray diffractometer. All d-values were assigned Miller indices determined by comparison with computer interplanar spacings consistent with space group extinctions. The densities and lattice constants were calculated, and the refractive indices were measured whenever possible. The calculated X-ray powder diffraction patterns were computed from published crystal structure data. Both peak height and integrated intensities are reported for the calculated patterns. Author

N72-13714# Joint Publications Research Service, Washington, D.C.
REACTANCE INVERSION OF (p-n)-JUNCTIONS
G. B. Abdullayev, Z. A. Iskender-Zade, E. A. Dzhafarova, M. R. Akhundov, and Sh. A. Alikhanova 10 Dec. 1971 4 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 200, no. 2, 1971 p 314-315
(JPRS-54674) Avail: NTIS

The validity of the equation for capacitative to inductive reactance conversion was investigated experimentally. The relation of the conditions of intense glow of diodes to the reactance

inversion was studied. The effect of the nature of the deep levels on the inversion parameter was also investigated. The reactance properties of p-n junctions created from n- and p-silicon, germanium, indium phosphide, and gallium phosphide (with green and red glow) were considered. The reactance conversion occurs at all p-n junctions created from single crystal semiconductors. The inversion voltage and its variation with temperature and frequency of the variable signal permit the determination of the concentration of the majority carriers in the base, the near-by potential distribution, the diffusion potential difference, and the local temperature of the p-n junction. K.P.D.

N72-13715# Joint Publications Research Service, Washington, D.C.

EFFECT OF TEMPERATURE AND THERMAL STRESS FIELDS ON THE FORMATION OF THE DISLOCATION STRUCTURE IN SINGLE CRYSTALS OF GALLIUM ARSENIDE GROWN BY THE CZOCHRALSKI METHOD

N. A. Avdonin, S. S. Vakhrameyev, M. G. Milvidskii, V. B. Osvenskii, B. A. Sakharov, V. A. Smirnov, and Yu. F. Shchelkin 10 Dec. 1971 6 p refs Transl. into ENGLISH from Dokl. Akad. Nauk SSSR (Moscow), v. 200, no. 2, 1971 p 316-319 (JPRS-54673) Avail: NTIS

An approach to solving the problem of the volumetric stressed state in the crystal was used. The temperature field was calculated on a computer, considering the boundary conditions obtained experimentally. Then the thermoelastic stress field was calculated. The volumetric distribution of the thermoelastic shear stresses obtained in this way were compared with corresponding values of yield stress for gallium arsenide, determined independently. This approach permits the analysis of the conditions of formation of dislocations during crystal growth. Single crystals of gallium arsenide were grown from a layer of molten boron anhydride in the /111/ direction. The stress field in the ingot was determined within the framework of the incoherent quasistatic theory of thermoelasticity. Author K.P.D.

N72-13716*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

EFFECT OF LOAD VOLTAGE ON THIN FILM CUPROUS SULFIDE: CADMIUM SULFIDE SOLAR CELLS THERMALLY CYCLED IN A SIMULATED SPACE ENVIRONMENT

John J. Smithrick and Ralph D. Thomas Washington Dec. 1971 12 p refs

(NASA-TN-D-6612; E-6419) Avail: NTIS CSCL 10A

Thin-film Cu2S-CdS solar cells, loaded at various fixed values of load resistance, were thermally cycled for 1429 cycles in a simulated space environment. Cell performance was measured under controlled conditions in air before and after thermal cycling. These data were used to determine the effect of load voltage on cell performance. The performance of the cells was relatively independent of load voltage up to about 0.39 volt. This appears to be a threshold voltage, beyond which there was a significant loss in cell performance. Fortunately, this threshold voltage appears to be sufficiently higher than the maximum power voltage of 0.33 volt so that it can be avoided in most applications. Author

N72-13717# Aerospace Research Labs., Wright-Patterson AFB, Ohio. Solid State Physics Research Lab.

AN INVESTIGATION OF THE SEMICONDUCTOR-TO-METAL TRANSITION IN CHLORINE DOPED CADMIUM SULFIDE USING NUCLEAR MAGNETIC RESONANCE Ph.D. Thesis - Ohio State Univ.

Frank D. Adams May 1971 226 p refs

(AF Proj. 7885-00-01)

(AD-728645; ARL-71-0088) Avail: NTIS CSCL 20/12

Spin-lattice relaxation times and Knight shifts were measured for Cd113 nuclei in twelve CdS crystals doped with various amounts of chlorine. Hall constants were also measured to obtain the conduction electron concentrations. Data were obtained on all samples at 300K and for some heavily doped samples at 77K, 4.2K and 2.13K. It was found that with increased doping, an impurity conduction band is formed in an electron concentration range (5. x 10 to the 17th power + n + 1.6 x 10 to the 18th power/cc). The impurity conduction band and CdS conduction band are merged when a further increase in dopant extends the electron concentration to (1.6 x 10 to the 18th power/cc + n + 2.4 x 10 to the 18th power/cc. All samples with n = 2.4 x 10 to the 18th power/cc have essentially metallic properties.

Author (GRA)

N72-13718# Stanford Univ., Calif. Microwave Lab.

MICROWAVE ACOUSTIC AND BULK DEVICE TECHNIQUE STUDIES Interim Technical Report, 1 Feb. - 30 Apr. 1971

Marvin Chodorow and H. J. Shaw Griffiss AFB, N. Y. RADC Jul. 1971 26 p refs

(Contract F30602-71-C-0125; Job Order 55730000)

(AD-728644; ML-1964; RADC-TR-71-144; ITR-2) Avail: NTIS CSCL 20/12

The objectives of the contract are to advance new theory and device techniques for the generation and processing of microwave signals using elastic, electromagnetic and carrier space charge waves in solid media. The work under the contract is presently divided into three projects, as follows: Acoustic parametric interactions; Wide bandwidth dispersive delay lines; and, Bulk and surface acoustic wave amplifiers. Author (GRA)

N72-13719# Columbia Univ., New York. Dept. of Civil Engineering and Engineering Mechanics.

COUPLED ELASTIC AND ELECTROMAGNETIC FIELDS IN A DIATOMIC, DIELECTRIC CONTINUUM

R. D. Mindlin Sep. 1971 31 p refs

(Contract N00014-67-A-0108-0027; NR Proj. 064-388)

(AD-728794; TR-20) Avail: NTIS CSCL 20/12

Huang's equations for coupled mechanical and electromagnetic fields in diatomic, ionic crystals are extended to accommodate shorter wave lengths and to include the acoustic branches of the dispersion relations for plane waves.

Author (GRA)

N72-13720# Columbia Univ., New York. Dept. of Civil Engineering and Engineering Mechanics.

GALERKIN STRESS FUNCTIONS FOR NON-LOCAL THEORIES OF ELASTICITY

R. D. Midlin Oct. 1971 23 p refs

(Contract N00014-67-A-0108-0027; NR Proj. 064-388)

(AD-728795; TR-21) Avail: NTIS CSCL 20/11

In the classical theory of elasticity, the potential energy density is a function of the strain whereas in the non-local theories the energy is a function of the strain and gradients of the strain, or parts thereof such as the rotation gradient which leads to couple stresses. For the classical theory, Galerkin exhibited a complete solution of the displacement equation of equilibrium in terms of a single vector function satisfying an equation of higher order but of simpler and more tractable form. In the present paper, after a review of the solutions for the classical and rotation gradient cases, the analogous solutions are exhibited for the non-local equations of higher and higher orders up to Cauchy's equation of infinite order for his asymptotic theory of an elastic medium with long range interactions between molecules in a periodic structure. Author (GRA)

N72-13721# Texas A&M Research Foundation, College Station.

CHARACTERIZATION OF CONDUCTION PROCESSES IN AMORPHOUS SEMICONDUCTORS Semiannual Technical Report

J. L. Stone 1971 46 p refs

(Grant DA-ARO(D)-31-124-71-G49; ARPA Order 1562)

(AD-728160; AROD-9352-1-P) Avail: NTIS CSCL 20/12

Several different samples of 2As2Se3.As2Te3, As2Se3, As2Te3, As2S3 and Si(3%) Ge(4%) As(38%) Te(55%) were used in the photodielectric tests. The experiment was performed on these samples at room temperature, liquid nitrogen temperature (77K) and liquid helium temperature (4.2K) results are discussed.

GRA

N72-13722# New Mexico Univ., Albuquerque. Bureau of Engineering Research.
RADIATION EFFECTS ON GALLIUM ARSENIDE PHOSPHIDE AND GALLIUM PHOSPHIDE SCHOTTKY BARRIER DIODES
D. A. Neamen and W. W. Grannemann Jul. 1971 241 p refs
(Contract N00014-68-A-0158)
(AD-728800; EE-189(71); ONR-005) Avail: NTIS CSCL 09/1

Gallium arsenide phosphide (GaAsP) and gallium phosphide (GaP) Schottky barrier diodes were fabricated and the transient ionizing and stable fast neutron radiation effects on these diodes were determined. Author (GRA)

N72-13723# Illinois Univ., Chicago. Dept. of Materials Engineering.
DETERMINATION OF THE UNLOADING BOUNDARY IN TRANSVERSE IMPACT OF AN ELASTIC-PLASTIC STRING Summary Report, 1 Mar. 1970 - 28 Feb. 1971
Peter A. Tuschak and Albert B. Schultz Wright-Patterson AFB, Ohio AFML Jun. 1971 41 p refs
(Contract F33615-70-C-1020; AF Proj. 7351)
(AD-728241; AFML-TR-71-108; Task-735106) Avail: NTIS CSCL 20/11

When a thin, elastic-plastic wire is transversely impacted, both longitudinal and transverse loading waves propagate. For certain types of excitation, unloading waves also propagate, and they overtake and interact with the loading waves. These interactions occur on moving boundaries, and a knowledge of the locations of these boundaries is needed for the solution of wave propagation problems of this kind. An analytical technique and a numerical technique for the solution of such problems in long wires is presented. Examples, including response to impact by a finite mass, are given to illustrate the techniques. For finite length wires, the techniques will determine the initial portion of the solution. Author (GRA)

N72-13724# Delaware Univ., Newark. Dept. of Physics.
Ag DOPING OF CADMIUM SULFIDE AND ITS INFLUENCE ON ELECTRICAL PROPERTIES
Henry C. Hadley, Jr. Jun. 1971 65 p refs
(Contract N00014-71-C-0169)
(AD-728387; TR-2) Avail: NTIS CSCL 20/12

It was recognized that Ag doping was a significant factor in determining the electrical characteristics of CdS that produce negative differential conductivity (NDC) necessary for high field domains (HFD) in CdS. Doping with nitrates of Ag and Al was a method of obtaining CdS crystals exhibiting such phenomena, attributed to field quenching caused by field enhanced ionization. However, very little was known about the relationship between doping and the electrical characteristics that produce NDC. In order to gain some understanding of this relationship, the study of the effects of Ag doping on NDC was undertaken. It was the main purpose of this study to get a reliable procedure for doping with Ag and Al to obtain crystals for further studies of NDC and field quenching, and to what microscopic processes may be involved in the doping. Author (GRA)

N72-13725# California Inst. of Tech., Pasadena. Dept. of Physics.
CHANNELING EFFECT ANALYSIS OF LATTICE DISORDER IN BORON IMPLANTED SILICON
James Edward Westmoreland, III Apr. 1971 146 p refs
(Contract F19628-71-C-0056; AF Proj. 4608-05-01)
(AD-728709; AFCRL-71-0231; SR-1) Avail: NTIS CSCL 20/12

The report describes a method for obtaining consistent disorder distributions from helium and proton backscattering analyses of the disordered regions in boron implanted silicon. Measurements are given of temperature effects on the disorder in regions of low temperature where such effects were not anticipated. An application of the backscattering analysis technique to study the composition of thin layers is presented. Author (GRA)

N72-13726# University of Southern Calif., Los Angeles. Electrons Sciences Lab.
BASIC RESEARCH IN ELECTRONICS Semiannual Progress Report, 1 Oct. 1970 - 31 Mar. 1971
Mar. 1971 286 p refs
(Grant AF-AFOSR-1622-69; AF Proj. 4751)
(AD-728242; AFOSR-71-2200TR; SAPR-13) Avail: NTIS CSCL 20/12

Contents: Semiconductors; Quantum electronics and lasers; Magnetism; Defect chemistry and electrochemistry; Metals, alloys, insulators and low temperature physics; Solid state devices; Plasmas and applied electromagnetics; Control systems; Communications systems; Switching, automata theory, computers; Mathematical biosciences program; Biomedical engineering. GRA

N72-13727# Washington State Univ., Pullman. Dept. of Physics.
SHOCK WAVES IN SOLIDS Final Report
George E. Duvall 1 Aug. 1971 11 p refs
(Grant AF-AFOSR-1758-69; AF Proj. 9761)
(AD-728670; AFOSR-71-2158TR; Rept-61102F; Rept-681306)
Avail: NTIS CSCL 20/12

A procedure was developed for synthesizing a complete, solid equation of state and applied to iron. An experimental technique was developed for measuring shock induced magnetic anisotropy in YIG5. An improved procedure was developed for averaging magnetic moment in polycrystalline material. A theory of the asymptotic behavior of magnetization with field was developed for ferromagnetic materials. A code was written for 2-D elastic-plastic wave propagation in a bar. Analytic solutions for finite amplitude waves in lattices were developed. Author (GRA)

N72-13728# California Univ., Irvine.
SURFACE WAVE PHENOMENA
Richard F. Wallis 17 Jul. 1971 46 p refs
(Contract N00014-69-A-0200-9003; NR Proj. 015-731)
(AD-729063; TR-71-15) Avail: NTIS CSCL 20/12

In this account the author surveys a number of aspects of surface wave phenomena in crystals. The propagation of elastic surface waves is discussed for both isotropic and anisotropic cases. The effect of piezoelectricity on surface wave properties is considered. Optical surface modes of vibration in crystals having either short range or long range interactions are treated. An elementary theory of surface plasmons is presented both with and without an external magnetic field. A treatment of surface spin waves from both the microscopic and macroscopic viewpoints is given. Our survey is concluded with a discussion of the mean square displacements of atoms at crystal surfaces. Author (GRA)

N72-13729# Michigan Univ., Ann Arbor.
GENERATION OF MICROWAVE RADIATION IN InSb BY ACOUSTOELECTRIC AMPLIFICATION Ph.D. Thesis
W. J. Fleming Griffiss AFB, N. Y. RADC Jul. 1971 387 p refs
(Contract F30602-71-C-0099; Job Order 55730000)
(AD-729197; RADC-TR-71-151; TR-120) Avail: NTIS HC $6.00/MF $0.95 CSCL 20/12

On the basis of experimental results obtained herein, an original theoretical model is developed for the electrical instability manifested by microwave radiation from In Sb. The model depicts a continuous nucleation bf acoustic disturbances at plasma regions which are localized in the vicinity of the contacts, and subsequent amplification of off-axis acoustic waves as they propagate into the bulk of the In Sb specimen. The radiation arises via the conversion of the acoustical energy into microwave radiation; hence it is assumed that the field dependence of the radiation is determined by the growth rate of the acoustoelectric instability. A general formulation of the off-axis acoustoelectric interaction, specialized for III-V semiconductor compounds, is

fully developed. The particular case of the interaction in n-type /110/ oriented In Sb is analyzed and described in detail. It is shown that the major correction required to extend the hydrodynamical theory of the acoustoelectric interaction to microwave frequencies is the inclusion of electron inertial terms. Further analysis reveals that the physical mechanism for the emergence of a swparate high-field mode of acoustic-wave amplification (mode I) is the drift-enhanced quenching of electron diffusion effects. Low-field 10 Ghz noise radiation and attendant RF current oscillations are generated in 10-mm long specimens of n-type, /110/ oriented In Sb at 77 K. Author (GRA)

N72-13730# Johns Hopkins Univ., Baltimore, Md.
WAVE PROPAGATION IN ANISOTROPIC MEDIA Final Report, 20 Oct. 1969 - 28 Feb. 1971
Robert E. Green, Jr. Jun. 1971 13 p refs
(Contract DAAD05-70-C-0082)
(AD-729327; BRL-CR-41) Avail: NTIS CSCL 20/12

Work is reported on the improvement and extension of optical methods for studying elastic wave propagation in transparent crystals and on the influence of non-linear effects on elastic wave propagation in anisotropic crystals. Author (GRA)

N72-13731# Louisiana State Univ., Baton Rouge. Dept. of Physics and Astronomy.
APPLIED ENERGY BAND THEORY Final Report
Joseph Callaway Aug. 1971 11 p refs
(Grant AF-AFOSR-1565-68; AF Proj. 9763)
(AD-729224; AFOSR-71-2280TR) Avail: NTIS CSCL 20/12

The report summarizes accomplishments under the grant. The research proposed for this project involved five problems in theoretical solid state physics: (1) the study of spin waves in a model metallic ferromagnetic of face centered cubic structure; (2) the determination of the formation energy of a vacancy-interstitial pair in silicon; (3) a calculation of the wave function of donor states in gallium antimonide; (4) the investigation of exciton states in lithium and potassium bromide; and (5) the study of the semi-conductor to metal transition in nickel sulfide. Author (GRA)

N72-13732# Pennsylvania State Univ., University Park. Dept. of Engineering Mechanics.
A DISLOCATION THEORY OF PLASTICITY
Hong T. Hahn Sep. 1971 122 p refs
(Grant AF-AFOSR-1626-69; AF Proj. 9782)
(AD-729218; TR-3; AFOSR-71-1964TR) Avail: NTIS CSCL 20/12

The objective is to formulate a continuum theory of dislocations, which could serve as a connecting link between solid state physics and the conventional plasticity and viscoplasticity theories. In addition, a modification of the classical theory is undertaken so as to accomodate finite deformations. The main features are no assumption of infinitesimal deformation, multiplicative decomposition of the total deformation into a thermoelastic deformation and a plastic deformation, derivation of a kinematical relation between plastic flow and dislocation motion, formulation of a dislocation theory of plasticity, formulation of a finite deformation theory of classical plasticity and a discussion of elastic and plastic material symmetries, a note on the importance of plastic spin in general and a proof that it is absent in the theory of isotropic materials, and examples dealing with simple deformations. Author (GRA)

27 PROPELLANTS

Includes fuels; igniters; and oxidizers. For basic research see: 06 Chemistry; and 33 Thermodynamics and Combustion. For related information see also: 28 Propulsion Systems.

N72-13733*# Rocketdyne, Canoga Park, Calif.
SHUTTLE APS PROPELLANT THERMAL CONDITIONER STUDY Monthly Progress Report for Jul. 1971
D. L. Fulton Jul. 1971 108 p refs
(Contract NAS9-12046)
(NASA-CR-124766; ASR71-236; MPR-1) Avail: NTIS CSCL 21I

The conditioner design concept selected for evaluation consists of an integral reactor and baffle-type heat exchanger. Heat exchange is accomplished by flowing reactor hot gases past a series of slotted and formed plates, through which the conditioned propellant flows. Heat transfer analysis has resulted in the selection of a reactor hot gas nominal mixture ratio of 1.0, giving a combustion temperature of 1560 F with a hydrogen inlet temperature of 275 R. Worst case conditions result in a combustion gas temperature of 2060 F, satisfying the condition of no damage to the conditioner in case of failure to flow cold fluid. In addition, evaluation of hot gas flow requirements and conditioner weight has resulted in the selection of a reactor hot gas exhaust temperature of 750 R. Author

N72-13734*# Martin Marietta Corp., Denver, Colo.
DEVELOPMENT OF A METALLIC BELLOWS EXPULSION DEVICE FOR FLUORINE SERVICE Final Report
R. F. Fearn Oct. 1971 194 p refs
(Contract NAS3-12053)
(NASA-CR-72980; MCR-71-176) Avail: NTIS CSCL 21I

A complete expulsion device was designed, fabricated, and tested in accordance with requirements specified by NASA to demonstrate the feasibility of using metallic bellows to expel liquid fluorine. Difficulties were experienced in obtaining leaktight welds at the bellows end terminals, but eventually three assemblies were successfully fabricted and cycle tested, one in LN2, two in LF2. The bellows performed well, except that they failed prematurely in LF2, apparently the result of small initiator cracks in the seam welds of the bellows. Author

N72-13735*# Massachusetts Inst. of Tech., Cambridge.
POLYMER DEGRADATION RATE CONTROL OF HYBRID ROCKET COMBUSTION
David B. Stickler and Kumar N. R. Ramohalli Sep. 1970 43 p refs
(Grant NGL-22-009-383)
(NASA-CR-124726) Avail: NTIS CSCL 21I

Polymer degradation to small fragments is treated as a rate controlling step in hybrid rocket combustion. Both numerical and approximate analytical solutions of the complete energy and polymer chain bond conservation equations for the condensed phase are obtained. Comparison with inert atmosphere data is very good. It is found that the intersect of curves of pyrolysis rate versus interface temperature for hybrid combustors, with the thermal degradation theory, falls at a pyrolysis rate very close to that for which a pressure dependence begins to be observable. Since simple thermal degradation cannot give sufficient depolymerization at higher pyrolysis rates, it is suggested that oxidative catalysis of the process occurs at the surface, giving a first order dependence on reactive species concentration at the wall. Estimates of the ratio of this actiation energy and interface temperature are in agreement with best fit procedures for hybrid combustion data. Requisite active species concentrations and flux are shown to be compatible with turbulent transport. Pressure dependence of hybrid rocket fuel regression rate is thus shown to be describable in a consistent manner in terms of reactive species catalysis of polymer degradation. Author

N72-13736*# Rocketdyne, Canoga Park, Calif.
STABILIZED PROPELLANT Patent Application
Vernon E. Haury, inventor (to NASA) Filed 23 Sep. 1970 9 p
(Contract NAS7-661)
(NASA-Case-NPO-12000; US-Patent-Appl-SN-74861) Avail: NTIS CSCL 21I

A solid propellant composition that can contain the highly reactive oxidizer hydrazinium nitroformate, HNF is described. An

unsaturated carboxyl terminated hydrocarbon binder in a solid propellant composition (such as carboxyl terminated polybutadiene) is utilized. It was found that by incorporating a small amount of nitroguanidine into the propellant formulation the reaction between the HNF and the double bonds is inhibited thus providing a propellant with a satisfactory shelf life. Since HNF also attacks curing agents for the binders, it is preferred to utilize a particular curing agent which is not attacked ty the HNF. This curing agent is triethylene melamine. NASA

N72-13737*# National Aeronautics and Space Administration, Washington, D.C.
SOLID PROPELLANT SELECTION AND CHARACTERIZATION Space Vehicle Design Criteria
Jun. 1971 116 p refs
(NASA-SP-8064) Avail: NTIS CSCL 21I

The techniques of propellant selection and characterization and the compromises that may be forced on the designer by the change of a propellant parameter are discussed. Rules for the selection of a general propellant type are presented. The characterization of various propellant properties is then approached parameter by parameter. Tailoring pitfalls and compromises are identified whenever possible, and appropriate cross references are used. Related design criteria monographs frequently are cited for a more detailed treatment of the topic under discussion. A list of source references is provided. These references, coupled with established texts in the field, should give the depth of knowledge necessary to the designer to aid in the selection of the most nearly optimum propellant for the design application. Author

N72-13738# Army Missile Command, Redstone Arsenal, Ala. Propulsion Directorate.
ANALYSIS OF THE INTERIOR BALLISTICS OF MULTICHANNEL GRAINS
Joe D. Hoffman 30 Oct. 1970 49 p
(DA Proj. 1X5-23627-D-306)
(AD-728817; RK-TR-70-18; AMC-MS-Code-557E.12.46700) Avail: NTIS CSCL 21/9

An analysis of the interior ballistics of multichannel grains having a common fore and aft plenum is presented. This analysis, while general, has been implemented as a computer program for a specific type of scrolled grain. This program is described together with sample cases illustrating its use. Author (GRA)

N72-13739# Illinois Univ., Urbana.
A STUDY OF THE TRANSIENT BEHAVIOR OF FUEL DROPLETS DURING COMBUSTION: THEORETICAL CONSIDERATIONS FOR AERODYNAMIC STRIPPING Final Report
Herman Krier Jun. 1971 42 p refs
(Contract DAAD05-70-C-0111)
(AD-729326; AAE-70-4; BRL-CR-42) Avail: NTIS CSCL 21/2

The steady or quasi-steady combustion of isolated droplets or droplet sprays has been studied extensively and is reasonably well understood, but the problem of transient gas dynamics coupled to droplet combustion is poorly understood and adequate models to describe the phenomena have yet to be proposed. The problem is, however, extremely important to the technology of combustion devices. Aside from the detonation of spray droplet mixtures, in which droplet breakup and combustion are occurring under extremely transient conditions, a full descriptive theory of this phenomena will be invaluable in furthering an understanding of such phenomena as liquid rocket engine instabilities, engine thrust transients, combustion in liquid propellant gun systems, high pressure fuel-air gun systems, spray ignition mechanisms, and hybrid rocket dynamics. The report presents a theoretical analysis of one important phase of heterogeneous flow, a model for the aerodynamic stripping of fuel from the assumed spherical droplets. Author (GRA)

28 PROPULSION SYSTEMS

Includes air breathing, electric, liquid, solid, and magnetohydrodynamic propulsion. For nuclear propulsion see: 22 Nuclear Engineering. For basic research see: 23 Physics, General; and 33 Thermodynamics and Combustion. For applications see: 31 Space Vehicles. For related information see also: 27 Propellants.

N72-13740*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
ION THRUSTER DIAGNOSTICS USING SPECTRAL LINE AMPLITUDES
N. L. Milder and J. S. Sovey [1971] 10 p refs Presented at 10th Aerospace Sci. Meeting, San Diego, Calif. 17-19 Jan. 1972; Sponsored by AIAA
(NASA-TM-X-67965; E-6469) Avail: NTIS CSCL 21C

The optical radiation from the plasma discharge of an electron bombardment mercury ion thruster was investigated. Using the measured ratio of the Hg I line amplitude at 3655 A to that at 3650 A, a theory incorporating a bimodal electron distribution (Maxwell electrons plus primary electrons) was used to obtain the average electron temperature and primary electron fraction in the thruster ion chamber. The electron temperature ranged from about 1.2 eV to 6.6 eV; whereas the primary electron fraction varied from zero percent to about 5 percent. These values depended upon the discharge voltage and the radial location of the measurement. The percentage of doubly ionized mercury produced in the chamber was also determined as a function of discharge voltage. Author

N72-13741# Southampton Univ. (England). Dept. of Aeronautics and Astronautics.
PERFORMANCE OF LOW-THRUST AMMONIA RESISTOJETS
I. Edwards, and R. E. W. Jansson Sep. 1971 32 p refs
(AASU-307) Avail: NTIS

The results obtained from a theoretical gas dynamic model of resistojet performance were used in a parametric study to investigate design criteria for pulsed resistojet systems. It is shown that this application of the performance predictions is reasonable. The effects on performance of changes in nozzle geometry are discussed. Examination of the total impulse requirements of two representative satellites for initial acquisition of attitude and for attitude control shows that the optimization of the systems should be with respect to the second factor. It is further shown that for maximum performance the pulsed resistojet should operate at as high a temperature as possible, and the dissociation of ammonia should be encouraged by suitable design of the heater. Total performance can be optimized by minimizing the overall system mass (including power supplies, tankage, feed lines, resistojet deadweight, radiation shielding, and propellant mass), but only if total mission impulse and mission profile are defined. Author

N72-13742*# Mississippi State Univ., State College. Inst. of Environmental Sciences.
THE GEOMETRY AND PHYSICAL PROPERTIES OF EXHAUST CLOUDS GENERATED DURING THE STATIC FIRING OF S-I-C AND S-2 ROCKET ENGINES
Richard E. Forbes, Michael R. Smith, and Ralph R. Farrell Oct. 1971 106 p refs
(Grant NGL-25-001-032)
(NASA-CR-124761; IES-7-10-2) Avail: NTIS CSCL 21H

Numerical simulation techniques which permit the prediction of the growth and diffusion of exhaust clouds generated during the static firing of different size rockets were studied under various meteorological conditions. The data compiled consisted of photographic recordings of the time dependent growth and diffusion of the exhaust clouds during static firing of the

S-1C-13, -14 and -15, and the S-2-13, -14 and -15 rocket engines. Meteorological data in the ambient atmosphere were also collected. The results indicate that at low altitudes, the exhaust closely resembles a free-jet type flow. At upper altitudes, the structure is similar to a natural cumulus cloud. F.O.S.

N72-13743*# International Business Machines Corp., Huntsville, Ala. Electronics Systems Center.
A GUIDE TO ONBOARD CHECKOUT. VOLUME 4: PROPULSION
Sep. 1971 75 p
(Contract NAS9-11189)
(NASA-CR-115258; IBM-71W-00311-Vol-4) Avail: NTIS CSCL 21H

The propulsion system for a space station is considered with respect to onboard checkout requirements. Failure analysis, reliability, and maintenance features are presented. Computer analysis techniques are also discussed. K.P.D.

N72-13744*# Colorado State Univ., Fort Collins. Dept. of Mechanical Engineering.
AN EXPERIMENTAL INVESTIGATION OF A HOLLOW CATHODE DISCHARGE
P. J. Wilbur Dec. 1971 77 p refs
(Grant NGR-06-002-112)
(NASA-CR-120847) Avail: NTIS CSCL 21C

An experimental study of the effects of various modifications to the hollow cathode discharge region of a 20 cm electron bombardment ion thruster is presented. The introduction of electrical insulation between the main and cathode discharge regions is shown to have no significant effect on thruster performance. Adjustment of both the diameter and length of the cathode discharge region from the design condition are examined and the reduced sizes are shown to effect large improvements in propellant utilization when the thruster is operating at about 30% of the design thrust level. Performance improvements are shown to be less significant at higher thrust levels. The feasibility of using a high voltage tickler electrode to initiate the cathode-keeper discharge is considered and results obtained suggest this mode of startup is unsatisfactory. Author

N72-13745*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
OPERATION OF AN ELECTRON-BOMBARDMENT ION SOURCE USING VARIOUS GASES
David C. Byers and Paul D. Reader Washington Dec. 1971 21 p refs
(NASA-TN-D-6620; E-6557) Avail: NTIS CSCL 21C

An electron-bombardment ion thruster of the SERT 2 type was operated with xenon, krypton, argon, neon, nitrogen, helium, and carbon dioxide. The discharge performance with xenon, krypton, and argon was similar to that obtained previously with mercury. Mass spectrometer data indicated that the xenon contained no significant multiple ionization. Restriction of the beam area, with an associated decrease in discharge potential, was necessary to reduce multiple ionization with argon to a negligible level. This modification also resulted in more stable operation of the thruster. Performance with the remaining gases was poor because the basic thruster designed was optimized for operation with mercury. Author

N72-13746# Aerojet Liquid Rocket Co., Sacramento, Calif.
A MODEL OF THE HYPERGOLIC PROPELLANT POP PHENOMENA
B. R. Lawver May 1971 29 p refs Backup document for AIAA Synoptic scheduled for publication in Journal of Spacecraft and Rockets in App. 1972
Avail: NTIS

Rocket engine popping with hypergolically fueled engine systems of various Apollo stages is discussed. The pops were eliminated through trial and error since there were no design criteria for relating injector parameters to the popping. An investigation was undertaken to analyze the pop phenomena and to develop design criteria by which popping can be prevented in future hypergolically fueled rocket engines. Author

N72-13747# National Aerospace Lab., Tokyo (Japan).
DYNAMIC CHARACTERISTICS OF LIFT JET ENGINE JR 100 H
Kenji Nishio, Masanori Endo, Nanahisa Sugiyama, Takeshi Koshinuma, and Toshimi Ohata May 1971 31 p refs In JAPANESE; ENGLISH summary
(NAL-TR-238) Avail: NTIS

A numerical method is presented for obtaining the engine transfer function when the static performance and geometrical dimensions of the engine are known. The engine transfer functions of the JR-100 H engine were calculated experimentally by three methods: transient response, frequency response, and random signal. The results of the numerical and experimental methods were compared, and a comparative discussion of the experimental methods is presented. The effects of each component's performance on the transfer function were determined, and it was concluded that the random signal method is the most practical and accurate. Author

N72-13748# Army Missile Command, Redstone Arsenal, Ala. Ground Equipment and Materials Directorate.
AN EXPERIMENTAL CONCEPT FOR OPTIMIZING THE GEOMETRIC CONFIGURATION OF SMALL ROCKET MOTORS
Judson R. Griffin 25 May 1971 24 p refs
(DA Proj. 41806-D-17196)
(AD-728156; RL-TR-71-3; AMCMS-Code-5162.12.66006) Avail: NTIS CSCL 21/8

The purpose of this report is to present the results of a photoelastic stress analysis conducted on two configurations for a typical sustainer motor. This report presents a discussion of the design, construction, scale, etc., of the test models. GRA

N72-13749# ARO, Inc., Arnold Air Force Station, Tenn.
AN APPROXIMATE SOLUTION OF THE SUDDEN AREA EXPANSION FLOW PROCESS FOR FLOWS IN A ROTATING COODINATE SYSTEM Final Report, Dec. 1968 - Dec. 1969
J. W. Salvage AEDC Aug. 1971 90 p refs
(Contracts F40600-72-C-0003; AF Proj. 7065; ARO Proj. TW5001)
(AD-728732; ARO-ESF-TR-70-330; AEDC-TR-71-111) Avail: NTIS CSCL 21/5

An approximate quasi-three-dimensional method of solution is described for the sudden area expansion flow process in the relative coordinate system under the assumptions of frictionless, adiabatic flow of a perfect gas. The objective was to determine the radial variation of the flow properties at the trailing edge of a rotor given the measured flow properties downstream of the rotor through use of the stream-tube approximation. Results are derived from one configuration of the blunt trailing-edge supersonic compressor rotors tested at AEDC. The results are shown of neglecting the free turbulent shear flows occurring in the blade wakes in conjunction with neglecting large radial secondary flows. Author (GRA)

N72-13750# Cincinnati Univ., Ohio. Dept. of Aerospace Engineering.
EXPERIMENTAL INVESTIGATION OF GAS PARTICLE FLOW IN A SIMULATED AXIAL FLOW COMPRESSOR STAGE
W. Tabakoff, A. Hamed, and M. F. Hussein Jul. 1971 40 p ref
(Contract DAHC04-69-C-0016; Themis Proj.)
(AD-728489; THEMIS-AE-71-21; AROD-T-4-35E) Avail: NTIS CSCL 21/5

An experimental study of the effect of particle size and fluid velocity on the trajectories and velocities of solid particles entrained by a fluid, and passing through a simulated axial flow

compressor stage, is carried out. Conclusions concerning areas of blade surface subjected to erosion damage due to particle collisions are drawn. Pressure measurements of the particulate gas flow on the blade surfaces were obtained for various values of particle concentration for two different positions of the second cascade row. A subsonic cascade wind tunnel (described in reference 1) was used for testing the particulate flow through the simulated compressor stage. Author (GRA)

N72-13751# Naval Ship Systems Command, Washington, D.C.
GAS-TURBINE ENGINES OF HIGH-SPEED SHIPS
A. G. Kurzon, A. D. Mezheritskii, Yu. I. Mityushkin, V. Yu. Tikhoplav, and A. M. Topunov Oct. 1970 326 p Transl. into ENGLISH from the monograph Gazoturbinnye Ustanovki Bystrokhodnykh sudov, (Leningrad), 1969 323 p
(AD-729147; NAVSHIPS-TRANS-1244) Avail: NTIS HC $6.00/MF $0.95 CSCL 21/5

The report is devoted to the questions involved in the theory and designing of gas-turbine engines and installations for hovercraft and hydrofoil ships. Considerable attention is diverted to the questions of the engine's and propelling agent's interaction under the specific conditions of a ship using hydrofoils or an air cushion, as well as to the questions of using gas-turbine engines (GTE) on the air-cushion and hydrofoil type of ships, etc. The book is oriented toward engineers, designers and specialists on the hydrofoil and hovercraft power units. It will also prove useful for students and instructors at universities and advanced engineering schools specializing in this area of technology. The book contains 140 illustrations, 29 tables and a 117-item bibliography. Author (GRA)

N72-13001*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
MATERIALS FOR JET ENGINES
John C. Freche *In its* Vehicle Technol. for Civil Aviation 1971 p 85-106 refs (See N72-12995 04-02)
Avail: NTIS HC $6.00/MF $0.95 CSCL 21E

N72-13002*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
SUBSONIC AND SUPERSONIC PROPULSION
Milton A. Beheim, Robert L. Cummings, James F. Dugan, Jr., Charles E. Feiler, Jack S. Grobman, and Warner L. Stewart *In its* Vehicle Technol. for Civil Aviation 1971 p 107-156 (See N72-12995 04-02)
Avail: NTIS HC $6.00/MF $0.95 CSCL 21E

N72-13003*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
HYPERSONIC AIR-BREATHING PROPULSION SYSTEMS
John R. Henry and H. Lee Beach *In its* Vehicle Technol. for Civil Aviation 1971 p 157-177 refs (See N72-12995 04-02)
Avail: NTIS HC $6.00/MF $0.95 CSCL 21A

29 SPACE RADIATION

Includes cosmic radiation; solar flares; solar radiation; and Van Allen radiation belts. For related information see also: 13 Geophysics; and 24 Physics, Atomic, Molecular, and Nuclear.

N72-13752 National Lending Library for Science and Technology, Boston Spa (England).
AN ATTEMPT AT THE PHASING OF SYNOPTIC PROCESSES BY DEGREE OF ZONALITY IN THE 11-YEAR SOLAR CORPUSCULAR ACTIVITY CYCLE
T. V. Pokrovskaja [1971] 12 p refs Transl. into ENGLISH from Tr. Gl. Geofiz. Observ. (Leningrad), no. 258, 1970 p 3-17
(NLL-M-20938-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

Research on the effects produced by solar corpuscular radiation in the earth's pressure field is reviewed. The pressure change at the earth's surface by the fourth day after a geomagnetic disturbance is illustrated, and the meridional character of the pressure field formed as a result of corpuscular invasions is emphasized. The use of heliophysical, geomagnetic, and meteorological data for climatological and long-range forecasting purposes is discussed. Geomagnetic activity is described in detail, and correlations with solar activity and other geophysical disturbances are made. It is concluded that the results of several researchers indicate that atmospheric circulation is reorganized into a meridional type as a result of the solar corpuscular radiation. N.E.N.

N72-13753# Tokyo Univ. (Japan). Inst. of Space and Aeronautical Science.
NEUTRAL POINT DISCHARGE AS SIMULATION EXPERIMENT OF SOLAR AND TERRESTRIAL PLASMAS
Nobuki Kawashima and Nobuyoshi Ohyabu Jun. 1971 12 p refs
(ISAS-464-Vol-36-No-6) Avail: NTIS

Neutral sheet pinch was studied experimentally in order to simulate the space physical phenomena (solar flare, geomagnetic tail). Neutral sheet was produced by driving the plasma current at the neutral point of cusp and quadrupole magnetic field. Under the appropriate condition, sheet pinch collapses and plasma blobs are ejected along the magnetic field on the neutral plane, which is thought to be related to the ejection of plasma at solar flares. The mechanism of pinch collapses is also discussed concerned with the tearing mode of resistive instability. Author

N72-13754# Academy of Sciences (USSR), Moscow.
STEADY-STATE FLOW OF THE SOLAR WIND AROUND A DIPOLE
M. L. Brailovskiy and L. S. Frank 1971 31 p refs In RUSSIAN
(PR-77) Avail: NTIS

Asymptotic behavior of the magnetic field of a dipole at great distances is considered during solar wind flow about it. A theoretical formula is derived and utilized for interpretation of experimental data on the earth's magnetic field.
Transl. by K.P.D.

N72-13755*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
A NOTE ON THE EFFECT OF REFLECTED SOLAR RADIATION ON AIRBORNE AND GROUND MEASUREMENTS IN THE THERMAL INFRARED
Victor S. Whitehead Jul. 1971 19 p refs
(NASA-TM-X-58059) Avail: NTIS CSCL 03B

The magnitude of thermal solar radiation reflected from water surfaces is considered. It is shown both theoretically and by field observation that, for instruments with small fields of view, the reflected thermal solar radiation can contribute significantly to the measured energy. Comparison of thermal scanner data taken from aircraft at a 16 deg azimuth angle from the mirror point of the sun over the open ocean with data taken at a 164 deg anzimuth angle from the mirror point of the sun at the same angle from nadir is indicative of a difference of 2.8 K in the equivalent black body radiation temperature. Observations taken from a surface vessel into sunglint 80 deg from nadir are indicative of an equivalent black body radiation temperature that is 34 K warmer than the temperature obtained at a similar nadir angle away from the sunglint. Author

N72-13756*# Arkansas Univ., Little Rock. Dept. of Mathematics and Engineering.
SUNSPOT ANALYSIS AND PREDICTION Final Technical Report
Carl C. Steyer 14 Oct. 1971 85 p refs

(Contract NAS8-21179)
(NASA-CR-121059) Avail: NTIS CSCL 03B

An attempt is made to develop an accurate functional representation, using common trigonometric functions, of all existing sunspot data, both quantitative and qualitative, ancient and modern. It is concluded that the three periods of high sunspot activity (1935 to 1970, 1835 to 1870, and 1755 to 1790) are independent populations. It is also concluded that these populations have long periods of approximately 400, 500, and 610 years, respectively. The difficulties in assuming a periodicity of seven 11-year cycles of approximately 80 years are discussed. N.E.N.

N72-13757*# Maryland Univ., College Park. Dept. of Physics and Astronomy.
BALLOON MEASUREMENTS OF THE ENERGY SPECTRUM OF COSMIC ELECTRONS BETWEEN 1 GeV AND 25 GeV
James A. Earl, Dennis E. Neely, and Thomas A. Rygg Sep. 1971 42 p refs Revised
(Grants NGR-21-002-066; NGR-21-002-008; Contract Nonr-710(19))
(NASA-CR-124735; TR-72-038) Avail: NTIS CSCL 04A

During three balloon flights made in 1966 and 1967, cosmic electrons were investigated with the aid of a hodoscope detector which provided extensive and detailed information on each cosmic ray event triggering the apparatus. Similar information obtained during calibration exposures to protons and pions as well as to electrons was used to provide identification of cosmic electrons and to determine their energies. Differential primary electron intensities measured in the range from 1 GeV to 25 GeV were substantially larger than some earlier measurements. Taken in conjunction with existing measurements at energies above 100 GeV, this indicates that the energy spectrum of cosmic electrons is steeper than that of cosmic-ray nuclei and, consequently, suggests that Compton/synchrotron energy loss plays a significant role in shaping the electron spectrum. Author

N72-13758*# Hale Observatories, Pasadena, Calif.
ABSOLUTE INTENSITY CALIBRATIONS OF SOLAR K LINE PROFILES
Jay Pasachoff, M. [1971] 17 p refs
(Grants NGL-05-002-034; NSF GA-24015)
(NASA-CR-124676) Avail: NTIS CSCL 03B

Individual K-line profiles from elements of fine structure on the surface of the sun are calibrated absolutely. The continuum calibrations of Labs and Neckel and of Houtgast and Namba are considered, and the average K-profile is scaled to that of White and Suemoto. The ranges of intensities across a high-resolution spectrogram are tabulated for various parts of the line profile. Although the spatially-averaged value for K3 of 4.2% of the continuum corresponds to a brightness temperature of 4155 deg K, minimum and maximum values were 3980 and 4360 K, respectively. Similarly, K2v ranges from 4200 to 4560 K, and K2r from 4180 to 4460 K in small elements about 1 arc sec across. Author

N72-13759# Osservatorio Astrofisico di Arcetri, Florence (Italy).
[SOLAR FLARE MEASUREMENTS AT THE ARCETRI ASTROPHYSICAL OBSERVATORY DURING 1967]
Florence Univ. 1970 112 p refs In ITALIAN
(Fasc-95) Avail: NTIS

Tables of data on observations of solar flares made at Arcetri observatory during 1967 are presented. Lifetime, position and importance of the solar flares were determined for this period, using: (1) optical observations, (2) photographic records obtained with a camera coupled to a Halle monochromator and a Peratoner refractometer, and (3) spectrograms measured by a spectroheliograph. ESRO

N72-13760# Academy of Sciences (USSR), Moscow. Inst. for Space Research.
GALACTIC "SPURES" AS POSSIBLE SOURCES OF SOFT X RADIATION
I. S. Shklovski and E. K. Sheffer (Natl. Astron. Inst. P. K. Sternberg) 1971 14 p refs In RUSSIAN and ENGLISH
(PR-64) Avail: NTIS

An hypothesis on the origin of soft X-ray sources in the galaxy is given. Available data on X-ray background radiation measured at different galactic latitudes are analyzed. It is concluded that soft X-ray emission observed at low galactic latitude is due to remnant of type 2 supernovae outburst while the emission at high latitude is due to spures remnant of supernovae outburst located in the vicinity of the sun. ESRO

N72-13761# Imperial Coll. of Science and Technology, London (England).
THE MECHANISM OF EAS RADIO EMISSION
H. R. Allan, J. K. Jones (Leeds Univ.), N. Mandolesi (CNR, Bologna), J. H. Prah (Cape Coast Univ.), and P. Shutie 1971 6 p refs Presented at the 12th Intern. Conf. on Cosmic Rays, Hobart, Australia, 16-25 Aug. 1971 Sponsored in part by ESRO
Avail: NTIS

The amplitude of the radio pulses emitted by extensive air showers of energy 10 to the 17th power to 10 to the 18th power eV was studied with a radio receiving system. Six radio receiving channels operated simultaneously, two each at 32, 60, and 105 MHz. From the two components of the electric field measured in the ground plane, the field strength in a plane perpendicular ot the shower axis is calculated, assuming a geomagnetic mechanism, and after normalization, is plotted against R, the distance of the shower core from the antenna, with and without zenith angle correction, at 32 MHz. ESRO

N72-13762# Danish Space Research Inst., Lyngby.
NEON FLASH TUBE ARRAYS AS TRAJECTORY DEFINING ELEMENTS FOR HEAVY NUCLEI
D. Andrews, O. Corydon Petersen, O. Funch, and M. Rotenberg 1971 6 p refs Sponsored in part by ESRO
Avail: NTIS

An instrument consisting of layers of neon flash tubes, for measuring track coordinates of heavy primary cosmic ray particles is described. Two Cerenkov counters and three spark chambers with wire spacings of 2mm were used to determine the particle track. A neon flash tube detector, consisting of two X and two Y layers of tubes, was placed between the top and middle spark chambers. 5900 events were recorded during a balloon flight. For each event the track coordinates in the flash tube detector were calculated from the spark chamber data and compared with observations. It is shown, that a neon flash tube detector can record trajectories of high energy particles of all charges. By introducing a delay in applying high voltage and making this delay charge-dependent, the detector has virtually 100% efficiency for recording the track of the nucleus and a high discrimination power against accompanying knock-on electrons. ESRO

N72-13763# Royal Inst. of Tech., Stockholm (Sweden). Dept. of Plasma Physics.
LABORATORY EXPERIMENT ON THE INTERACTION OF A FAST PLASMA STREAM WITH UNMAGNETIZED BODIES
Lars Kristoferson Sep. 1971 27 p refs
(TRITA-EPP-71-28) Avail: NTIS

Results are presented from an experiment on the interaction between a supersonic plasma stream and unmagnetized spherical bodies with different conductivities. Streaming conditions around the bodies are investigated. Amplification of magnetic fluctuations from the plasma are studied for a two-layered body, and good agreement is obtained with a simple theory. The results are compared with recent observations of the solar wind - moon interaction. Author (ESRO)

N72-13791*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
RADIO PROPAGATION MEASUREMENTS OF THE SOLAR CORONA AND GRAVITATIONAL FIELDS: APPLICATIONS TO MARINER 6 AND 7
Duane O. Muhleman, John D. Anderson, Pasquale B. Esposito, and Warren L. Martin *In its* Proc. of the Conf. on Exptl. Tests of Gravitation Theories 1 Nov. 1971 p 92-104 refs (See N72-13776 04-30)
Avail: NTIS CSCL 03B

N72-13792*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
PROBING THE SOLAR PLASMA WITH MARINER RADIO TRACKING DATA
P. F. MacDoran, P. S. Callahan, and A. I. Zygielbaum *In its* Proc. of the Conf. on Exptl. Tests of Gravitation Theories 1 Nov. 1971 p 105-110 refs (See N72-13776 04-30)
Avail: NTIS CSCL 03B

N72-13793*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
A MEASUREMENT OF THE GENERAL RELATIVISTIC TIME DELAY WITH DATA FROM MARINERS 6 AND 7
John D. Anderson, Pasquale B. Esposito, Warren L. Martin, and Duane O. Muhleman *In its* Proc. of the Conf. on Exptl. Tests of Gravitation Theories 1 Nov. 1971 p 111-135 refs (See N72-13776 04-30)
Avail: NTIS CSCL 03B

N72-13803*# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
STUDY OF THE DETERMINATION OF THE COEFFICIENTS BETA AND GAMMA OF THE GENERALIZED METRIC OF ROBERTSON AND OF THE DYNAMICAL OBLATENESS OF THE SUN
Christian Marchal *In* JPL Proc. of the Conf. on Exptl. Tests of Gravitation Theories 1 Nov. 1971 p 222-227 refs (See N72-13776 04-30)
Avail: NTIS CSCL 03B

N72-13806*# European Space Operations Center, Darmstadt (West Germany).
ON THE ACCURACY OF THE RELATIVISTIC PARAMETERS BETA, GAMMA, AND THE SOLAR OBLATENESS COEFFICIENT J2, AS DEDUCED FROM RANGING DATA OF A DRAG-FREE SPACE PROBE
E. A. Roth *In* JPL Proc. of the Conf. on Exptl. Tests of Gravitation Theories 1 Nov. 1971 p 242-244 refs (See N72-13776 04-30)
Avail: NTIS CSCL 03B

30 SPACE SCIENCES

Includes astronomy and astrophysics; cosmology; lunar and planetary flight and exploration; and theoretical analysis of orbit and trajectory. For related information see also: 11 Facilities, Research and Support; and 31 Space Vehicles.

N72-13764 National Lending Library for Science and Technology, Boston Spa (England).
ON SOME FEATURES OF SEASONAL CHANGES IN THE GENERAL CIRCULATION PRIOR TO A COOL SUMMER OR A HOT SUMMER IN VIEW OF THE RECENT CLIMATIC VARIATION
Sahei Yaegashi [1971] 8 p refs Transl. into ENGLISH from Kishocho Keniyu Jiho (Tokyo), v. 22, 1970 p 1-7
(NLL-M-20888-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

A comparative study of seasonal variation in circulation was made in order to determine whether circulation characteristics for a 12 month period control or greatly affect subsequent variation in a circulation field. The period from autumn to the following cold summer was compared with a similar period beginning in autumn and ending in a hot summer. Perfectly symmetrical circulation differences were observed. K.P.D.

N72-13765 National Lending Library for Science and Technology, Boston Spa (England).
[CONTRIBUTION TO THE KNOWLEDGE OF METEORITIC COHENITES]
N. Illner [1971] 36 p refs Transl. into ENGLISH from Chem. Erde (West Germany), v. 28 1970 p 332-333, 338-349, and 354-369 In GERMAN and ENGLISH
(NLL-M-20941-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 4 NLL photocopy coupons

A mineralogical and geochemical analysis of cohenite from the Magura iron meteorite was made. The data obtained was compared with that available for cementite in order to study the genesis of cohenite. Orientation relations between cohenite and taenite (meteoritic austenite), and lattice faults in cohenite crystals, are discussed. Cohenite is interpreted as the terrestrial or meteoritic Fe3C analog of the iron carbide Fe3C obtained by metallurgical processes. K.P.D.

N72-13766 National Lending Library for Science and Technology, Boston Spa (England).
ON THE THRESHOLD OF NEW ACCOMPLISHMENTS: SCIENTIFIC SIGNIFICANCE OF SALYUT PERMANENT ORBITAL STATION FLIGHT
B. Petrov 13 Jul. 1971 3 p Transl. into ENGLISH from Pravda (Moscow), 1971
(NLL-M-20752-(5828.4F); NLL-117H9109/B) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

The Salyut spacecrew was constantly engaged in observing and photographing atmospheric formations, typhoons, cyclones, cloud blankets and geologically outstanding patches on the earth's surface. The cosmonauts also carried out experiments in measuring the level and the tissue doses of radiation, micrometeorite observations, measurements of the ionospheric parameters, and studies of the spatial distribution of charged particles near the space station. G.G.

N72-13767*# California Univ., Santa Cruz. Earth Sciences Board.
MATRIX CHARACTERISTICS AND ORIGIN OF LUNAR BRECCIA SAMPLES NO. 12034 AND 12073
A. C. Waters, R. V. Fisher (Calif. Univ., Santa Barbara), R. E. Garrison, and Daniel Wax [1970] 29 p refs
(Contract NAS9-10331)
(NASA-CR-124612) Avail: NTIS CSCL 03B

The transmission electron microscope was used to investigate the nature of the matrix in two samples of lunar breccia. This matrix is composed largely of tiny (0.5 microns) grains of unaltered glass which are plastically fitted against one another, and tightly welded to the clastic fragments with which they are in contact. The breccias have an open framework of angular clastic particles composed mainly of anorthositic, basaltic and glassy fragments. Most of the anorthositic fragments have been shock metamorphosed. Over half of the glassy clasts, and also the former diaplectic glass particles produced from shocked plagioclase, were partly or wholly devitrified before inclusion in the present breccias. It is concluded that each breccia was deposited from a hot basesurge cloud of impact debris, and the tiny bits of glass in the matrix condensed from rock that was volatilized by the heat of major meteorite impact. Author

N72-13768*# Geological Survey, Washington, D.C.
PRELIMINARY DESCRIPTION OF APOLLO 15 SAMPLE ENVIRONMENTS

G. A. Swann, M. H. Hait, G. G. Schaber, V. L. Freeman, G. E. Ulrich, E. W. Wolfe, V. S. Reed, and R. L. Sutton Sep. 1971 255 p refs
(NASA Order T-65253-G)
(NASA-CR-124730; Rept-36) Avail: NTIS CSCL 03B

Approximately 78 kg of lunar rock and soil samples were returned by Apollo 15. The rather complete documentation of the locations of nearly all of the samples allows for relating the samples to the specific and detailed geologic environments from which they were collected. This is especially important in an area as geologically complex as the Hadley-Apennine site. All of the material presented was derived from the pre-mission photogeologic maps, lunar surface television video tapes, air-to-ground transcript and crew debriefings, photographs taken on the lunar surface by the Apollo 15 crew, and information supplied by the Lunar Sample Preliminary Examination team from which the samples were categorized into groups consisting of, broadly, basalts and breccias. The breccias are considered loosely in terms of coherent breccias and soil breccias. Author

N72-13769*# GCA Technology Div., GCA Corp., Bedford, Mass.
A STUDY OF PLANETARY METEOROLOGY Quarterly Progress Report, 26 Mar. - 30 Jun. 1971
George Ohring 19 Jul. 1971 37 p refs
(Contract NASw-2221)
(NASA-CR-124731; QPR-1) Avail: NTIS CSCL 03B

Preliminary estimates are prepared of the weighting functions of the infrared bands of methane, ammonia, and hydrogen for the Jovian atmosphere. Together with the infrared spectral emission observations of Jupiter, these weighting functions are used to obtain a rough estimate of the vertical temperature profile in the Jovian atmosphere. Author

N72-13770*# National Aeronautics and Space Administration, Washington, D.C.
ASTROMETRICAL RESEARCH
V. P. Shcheglov, ed. Nov. 1971 137 p refs Transl. into ENGLISH of the book "Astronometricheskiye Issledovaniya" Tashkent, FAN Press, 1969 p 3-105
(NASA-TT-F-625) Avail: NTIS CSCL 03A

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N72-13771*# National Aeronautics and Space Administration, Washington, D.C.
INVESTIGATION OF FIVE DIFFUSE STAR CLUSTERS
Kh. Z. Ishmukhamedov *In its* Astrometrical Res. Nov. 1971 p 1-26 refs (See N72-13770 04-30)
Avail: NTIS CSCL 03A

Results are presented of an investigation of the diffuse star clusters NGC 1502, NGC 2422, NGC 7380, NGC 7788, and NGC 7790. Three criteria are used in determining whether a star is a cluster: the position of the star in the color-magnitude diagram (V, (B-V)); its position in the two-color diagram ((U-B), (B-V)); and the star's proper motion. The proper motion criterion was applied by means of Ebbighausen's method. In cases where the instellar absorption was found to vary from point to point across a cluster, the individual color excesses of the stars were considered. For cluster NGC 7788, 38 stars satisfied the criteria; for NGC 7790, there were 30 stars including a Cepheid variable, CF Cas, and an eclipsing variable; QX Cas; for NGC 2422, 45 definite members including a giant star; for NGC 1502, 35 stars; and for NGC 7380, 25 stars turned out to be definite members. Calculations were made of the absolute proper motions and tangential velocities of the clusters corrected for solar motion. Then using the known radial velocities, the total space peculiar velocities of the clusters were calculated. Author

N72-13772*# National Aeronautics and Space Administration, Washington, D.C.
PROPER MOTIONS OF FOUR VARIABLE STARS OF THE U GEMINORUM TYPE AND STARS IN THEIR VICINITY
Sh. Primkulov *In its* Astrometrical Res. Nov. 1971 p 27-55 refs (See N72-13770 04-30)
Avail: NTIS CSCL 03A

The proper motions of SS Aur, X Leo, TW Vir, and UZ Ser are derived from 1st epoch plates taken in 1935 with the Tashkent normal astrograph and 2nd epoch plates taken with the same instrument. A catalog of relative proper motions for 1946 stars to the 15th photographic magnitude located near the four U Geminorum stars is presented. The proper motion of the variable star R Leo was also determined. As a result of the proper motion studies, some binary and multiple star systems were found among the background stars. Author

N72-13773*# National Aeronautics and Space Administration, Washington, D.C.
PHOTOELECTRIC METHOD OF RECORDING STAR TRANSITS AND ITS APPLICATION AT THE ASTRONOMICAL INSTITUTE OF THE ACADEMY OF SCIENCES OF THE UZBEK SSR
T. Nuraliyev *In its* Astronometrical Res. Nov. 1971 p 56-80 refs (See N72-13770 04-30)
Avail: NTIS CSCL 03A

A photoelectric transit instrument employing a constant current photoelectric adapter was developed. A quartz clock provides time signals, and the photoelectric unit employs two photomultiplier tubes arranged in phase opposition. The amount of the delay in the system is determined mainly by the value of the time constant of the electrometer tube input. The photoelectric transit instrument was used at the Pulkovo Observatory to determine 55 time corrections in 1965. The average difference between the photoelectric transit data and etalon time was found to be +0s.022. An increase in temperature produces a decrease in the instrument's azimuth. The correction to the accepted longitude of the Astronomical Institute in Tashkent was determined to be +0.021. The longitude difference between Pulkovo and Tashkent was found to be 2h 35m 51s.903 + or - 0s.004, resulting in an agreement of the Tashkent longitude within 0s.001 with the earlier value obtained by Shcheglov.
Author

N72-13774*# National Aeronautics and Space Administration, Washington, D.C.
DIFFERENTIAL CATALOGUE OF RIGHT ASCENSIONS OF 102 STARS OF THE TASHKENT WIDE ZENITH ZONE
E. A. Sanakulov *In its* Astrometrical Res. Nov. 1971 p 81-101 refs (See N72-13770 04-30)
Avail: NTIS CSCL 03A

The stars were divided into hour groupings and observed visually by the group method, since 122 reference stars, 48 equatorial stars, and 12 northern stars were included in the program in addition to the 102 program stars from 25 to 53 deg in declination. A sighting mark 80.3 m north of the transit pavilion was used to check on the instrument's azimuth. Transit data was recorded by a writing chronograph. A quartz clock was used as a time reference check. Data from 117 nights from October 1964 to June 1966 were used in the final reduction. On the average each program star was observed 19 times. The mean square error of a single determination of the right

ascension of a catalogue star was + or -0s.023 for the zenith zone. A comparison of the catalog with FK4 by means of the GC reveals a systematic error as large as 0s.01, explained as being due to an accumulation of accidental errors and the inaccuracy of the catalogs. Corrections to the right ascensions of the 12 northern stars were determined and a differential catalog for them based on the FK4 system is given. Author

N72-13775*# National Aeronautics and Space Administration, Washington, D.C.
INVESTIGATION OF THE PIVOTS OF THE TASHKENT MERIDIAN CIRCLE
O. S. Tursunov *In its* Astrometrical Res. Nov. 1971 p 102-134 refs (See N72-13770 04-30)
Avail: NTIS CSCL 03A

The pivots of the Tashkent meridian circle were investigated with an axial microscope-micrometer and with a Type IKPV interferometer. The first method consists of mounting a glass plate marked with reference gaps separated by 2-3 microns on one of the pivots and measuring with a microscope-micrometer the change in position of the two geometrical axes of the instrument with respect to each other. The deviation of the pivots from their ideal circular shape is determined. It was found that one of the pivots of the meridian circle has an ellipticity in its working cross section which causes most of the errors. The investigation using the contact interferometer is affected by the interaction of the interferometer probe with the pivot such that the presence of pits on the pivots results in strong distortion of the corrections determined at the points of interaction of the supports with the pits. The interferometer results using flat and spherical probes agree well except at places where the pits are situated. A comparison of the interferometer results with the microscope-micrometer results reveals satisfactory agreement. Author

N72-13776*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
PROCEEDINGS OF THE CONFERENCE ON EXPERIMENTAL TESTS OF GRAVITATION THEORIES
R. W. Davies, ed. 1 Nov. 1971 261 p refs Conf. held at Pasadena, Calif., 11-13 Nov. 1970; sponsored by NASA, ESRO, and JPL
(Contract NAS7-100)
(NASA-CR-124710; JPL-TM-33-499) Avail: NTIS CSCL 03B

Varied experiments and studies are presented on gravitation theory, gravitational waves, satellite observation, relativity, and Doppler systems. Philosophies on both the operational and theoretical levels are compared. For individual titles, see N72-13777 through N72-13809.

N72-13777*# Hale Observatories, Pasadena, Calif.
THE COSMIC HELIUM ABUNDANCE
Leonard Searle *In* JPL Proc. of the Conf. on Exptl. Tests of Gravitation Theories 1 Nov. 1971 p 1-3 refs (See N72-13776 04-30)
Avail: NTIS CSCL 03B

Cosmic helium abundance was studied through the interior structure of young stars, profiles of helium absorption lines in the photospheric spectra of hot young stars, and emission-line spectrum of ionized gas. It is concluded that helium occurred before galaxies were formed. Inconsistencies found in the quasar spectra are briefly mentioned. J.A.M.

N72-13778*# Princeton Univ. Observatory, N.J.
STELLAR AND SOLAR ROTATION
Jeremiah P. Ostriker *In* JPL Proc. of the Conf. on Exptl. Tests of Gravitation Theories 1 Nov. 1971 p 4-9 refs (See N72-13776 04-30)
(Contract F44620-70-C-0033)
Avail: NTIS CSCL 03B

The angular momentum of stars and its distribution within the stars are discussed. Observed surface velocities dependent on a variety of factors are examined, including age, mass, spectral type, and binarism. The rotation and surface velocity of the sun are also considered. J.A.M.

N72-13779*# California Inst. of Tech., Pasadena.
THEORETICAL FRAMEWORKS FOR TESTING RELATIVISTIC GRAVITY: A REVIEW c13
Kip S. Thorne, Clifford M. Will, and Wei-Tou Ni *In* JPL Proc. of the Conf. on Exptl. Tests of Gravitation Theories 1 Nov. 1971 p 10-31 (See N72-13776 04-30)
(Grants NSF GP-19887; NSF-GP-27304)
Avail: NTIS CSCL 08N

Metric theories of gravity are presented, including the definition of metric theory, evidence for its existence, and response of matter to gravity with test body trajectories, gravitational red shift, and stressed matter responses. Parametrized post-Newtonian framework and interpretations are reviewed. Gamma, beta and gamma, and varied other parameters were measured. Deflection of electromagnetic waves, radar time delay, geodetic gyroscope precession, perihelion shifts, and periodic effects in orbits are among various studies carried out for metric theory experimentation. J.A.M.

N72-13780*# Montana State Univ., Bozeman.
TESTS OF THE EQUIVALENCE PRINCIPLE AND GRAVITATION THEORY USING SOLAR SYSTEM BODIES c13
Kenneth Nordtvedt, Jr. *In* JPL Proc. of the Conf. on Exptl. Tests of Gravitation Theories 1 Nov. 1971 p 32-37 refs (See N72-13776 04-30)
Avail: NTIS CSCL 03B

The M sub g/M sub i ratio (ratio of body acceleration to gravitation field) of celestial bodies was measured. Deep probes of the post-Newtonian structure of gravitational theories are indicated. Kepler's third law is considered for the Sun-Jupiter system. J.A.M.

N72-13781*# Louisiana State Univ., Baton Rouge.
A LOW TEMPERATURE GRAVITATIONAL RADIATION DETECTOR c14
William O. Hamilton *In* JPL Proc. of the Conf. on Exptl. Tests of Gravitation Theories 1 Nov. 1971 p 38-40 (See N72-13776 04-30)
Avail: NTIS CSCL 14B

The beginning design of an experiment is discussed for studying gravitational radiation by using massive detectors which are cooled to ultralow temperatures in order to improve the signal to noise ratios and the effective range and stability of the detectors. The gravitational detector, a low detection system, a cooled detector, magnetic support, superconducting shielding, and superconducting accelerometer detector are described. J.A.M.

N72-13782*# Rochester Univ., N.Y.
PROPERTIES OF HOLLOW SQUARE GRAVITATIONAL WAVE DETECTORS c14
D. H. Douglass, Jr. *In* JPL Proc. of the Conf. on Exptl. Tests of Gravitation Theories 1 Nov. 1971 p 41-44 refs (See N72-13776 04-30)
Avail: NTIS CSCL 14B

Antennas are described with gravitational radiation properties such as polarization, directivity, and scalar and tensor characteristics. These antenna devices are mechanically resonant systems in the shape of a hollow square with fundamental frequencies in the Hz range. An antenna characteristic is that the absorption cross section for quadrupole radiation at the normal frequency of vibration is the same as that of the fundamental if the damping factors are the same. The absorption cross section of quadrupole gravitational radiation is calculated for a class-1 detector of a cylindrical cross section and for a class-2 detector shaped like a hollow square. J.A.M.

N72-13783*# Moscow State Univ. (USSR).
ON THE HETERODYNE METHOD OF DETECTING GRAVITATIONAL WAVES c13
V. B. Braginsky and V. S. Nazarenko *In* JPL Proc. of the Conf. on Exptl. Tests of Gravitation Theories 1 Nov. 1971 p 45-46 refs (See N72-13776 04-30)
Avail: NTIS CSCL 08N

A mathematical model on the heterodyne method of detecting gravitational waves is presented, using a dumbbell consisting of two masses situated in a plane and a plane-fronted gravitational wave traveling perpendicular to the plane. It is concluded that the detector sensitivity is not likely to be improved without employing very complicated and expensive super low temperature techniques. J.A.M.

N72-13784*# Stanislaus State Coll., Turlock, Calif.
OBSERVATIONS OF EARTH EIGEN VIBRATIONS POSSIBLY EXCITED BY LOW FREQUENCY GRAVITY WAVES c13
V. S. Tuman *In* JPL Proc. of the Conf. on Exptl. Tests of Gravitation Theories 1 Nov. 1971 p 47-53 refs (See N72-13776 04-30)
Avail: NTIS CSCL 08N

A cryogenic gravity meter made of two parts, a magnetic suspension unit and a detection module, was used to monitor earth eigen vibrations. The magnetic field and field gradient are generated by energizing a set of superconducting coils made of niobium-zirconium alloy wire. The detection module is a double Josephson junction magnetometer. The output is printed on a chart recorder and later digitized using a computer; a Fourier transformation is performed on the accumulated data. The measurements of eigen vibrations are summarized in tabular and graphical representations. J.A.M.

N72-13785*# Smithsonian Astrophysical Observatory, Cambridge, Mass.
MEASUREMENT OF THE GRAVITATIONAL REDSHIFT USING A CLOCK IN AN ORBITING SATELLITE c13
R. F. C. Vessot (Harvard Coll. Obs.) and M. W. Levine (Harvard Coll. Obs.) *In* JPL Proc. of the Conf. on Exptl. Tests of Gravitation Theories 1 Nov. 1971 p 54-64 refs (See N72-13776 04-30)
(Contract nsr-09-015-098)
Avail: NTIS CSCL 03B

A hydrogen maser clock is proposed for enclosure in an orbiting satellite to measure the gravitational effect on time scales with high accuracy. This experiment is used to test the principle of equivalence for clocks in space. Extremely narrow linewidth of Fe-57 radiation and absorption due to Mossbauer effect over 75 ft vertical distance was used to confirm the prediction of the equivalence principle to 1 part in 100. The fractional frequency shift of a satellite-borne oscillator observed from earth is also given. J. A. M.

N72-13786*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
TESTS OF GENERAL RELATIVITY USING PULSARS
Paul E. Reichley *In its* Proc. of the Conf. on Exptl. Tests of Gravitation Theories 1 Nov. 1971 p 65-67 refs (See N72-13776 04-30)
Avail: NTIS CSCL 03A

The arrival times of the pulses from each pulsar are measured by a cesium clock. The observations are all made at a frequency of 2388 MHz (12.5 cm wavelength) on a 26 m dish antenna. The effect of interstellar charged particles is a random one that increases the noise level on the arrival time measurements. The variation in clock rate is shown consisting of two effects: the time dilation effect of special relativity and the red shift effect of general relativity. J.A.M.

N72-13787*# Stanford Univ., Calif.
THE STANFORD GYROSCOPE EXPERIMENT c14
C. W. F. Everitt *In* JPL Proc. of the Conf. on Exptl. Tests of Gravitation Theories 1 Nov. 1971 p 68-81 refs (See N72-13776 04-30)
(Grant NGR-05-020-019)
Avail: NTIS CSCL 14B

Gyroscopes in motion about a massive body are found to have two main effects: (1) geodetic effect, solely due to motion of the gryroscope about the earth and (2) motional effect, due to earth rotation. An experiment is proposed to measure the precession rate of one or more gyroscopes, mounted either on earth or in a satellite, with respect to the axis of a telescope pointing at a suitable fixed star. The procedures and apparatus to be used in this experiment are outlined; the error analysis is summarized. The relation of error to size, speed, and mechanical properties of rotor is presented, along with the design requirements for accuracy of 10 to the -16th power rad/s. J.A.M.

N72-13788*# Louisiana State Univ., Baton Rouge.
GYROSCOPE TEST OF GRAVITATION: AN ANALYSIS OF THE IMPORTANT PERTURBATIONS c14
R. F. OConnell *In* JPL Proc. of the Conf. on Exptl. Tests of Gravitation Theories 1 Nov. 1971 p 82-84 refs (See N72-13776 04-30)
Avail: NTIS CSCL 14B

Two perturbations, the earth's quadrupole moment and the earth's revolution around the sun, are discussed. Schiff's proposed gyroscope test of gravitation is analyzed, along with the capability of deciphering each separate contribution to the angular velocity of spin precession. J.A.M.

N72-13789*# Stanford Univ., Calif.
SOME FUTURE APPLICATIONS OF LOW TEMPERATURE TECHNOLOGY IN SPACE c23
William M. Fairbank *In* JPL Proc. of the Conf. on Exptl. Tests of Gravitation Theories 1 Nov. 1971 p 85-88 refs (See N72-13776 04-30)
Avail: NTIS CSCL 20L

Low temperature technology applications are presented for relativity experiments, improved signal to noise ratio performance, and helium studies in space. The large scale, low magnetic field facility is described, as well as the principle of the London moment for relativity gyroscopes. J.A.M.

N72-13790*# Wesleyan Univ., Middletown, Conn.
LIGHT DEFLECTION c23
Henry A. Hill (Arizona Univ.) *In* JPL Proc. of the Conf. on Exptl. Tests of Gravitation Theories 1 Nov. 1971 p 89-91 refs (See N72-13776 04-30)
(Grant NSF GP-9295)
Avail: NTIS CSCL 20F

A telescope was designed and fabricated which constitutes the primary piece of instrumentation in an experiment to obtain an improved measurement of the gravitational deflection of light. A Mark 2 solar oblateness detector was also designed and built. A preliminary study was made of the problems associated with the parallax measurement of spectroscopic binaries, and it indicates that for these objects distances up to 10 to the 5th power pc might be measured. J.A.M.

N72-13791*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
RADIO PROPAGATION MEASUREMENTS OF THE SOLAR CORONA AND GRAVITATIONAL FIELDS: APPLICATIONS TO MARINER 6 AND 7 c29
Duane O. Muhleman, John D. Anderson, Pasquale B. Esposito, and Warren L. Martin *In its* Proc. of the Conf. on Exptl. Tests of Gravitation Theories 1 Nov. 1971 p 92-104 refs (See N72-13776 04-30)
Avail: NTIS CSCL 03B

Results from interferometric measurements of the apparent angular deflection of quasi-stellar object are examined. Some preliminary results from Mariner 6 and 7 experiments, particularly from the plasma effect viewpoint, are discussed, along with

future experiments and plasma scintillation. Ray bending studies, plasma relativity separation for Mariner 6 and 7, and radio propagation test of general relativity are reviewed. First order approximations and time delay studies are appended, as well as Doppler velocity effect investigations. J.A.M.

N72-13792*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
PROBING THE SOLAR PLASMA WITH MARINER RADIO TRACKING DATA **c29**
P. F. MacDoran, P. S. Callahan, and A. I. Zygielbaum *In its* Proc. of the Conf. on Exptl. Tests of Gravitation Theories 1 Nov. 1971 p 105-110 refs (See N72-13776 04-30)
Avail: NTIS CSCL 03B

The range and Doppler radio tracking close to the sun made it possible to measure solar plasma dynamics. These were measured by means of a method known as differenced range versus integrated Doppler, which exploits the opposite change of group and phase velocity as the plasma density changes along tye radio raypath. A simple solar plasma propagation model is proposed. Author

N72-13793*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
A MEASUREMENT OF THE GENERAL RELATIVISTIC TIME DELAY WITH DATA FROM MARINERS 6 AND 7 **c29**
John D. Anderson, Pasquale B. Esposito, Warren L. Martin, and Duane O. Muhleman *In its* Proc. of the Conf. on Exptl. Tests of Gravitation Theories 1 Nov. 1971 p 111-135 refs (See N72-13776 04-30)
Avail: NTIS CSCL 03B

The technique for obtaining range measurements is discussed. It involves measuring elapsed time between the transmission of an encoded signal from the ground station and its return from the spacecraft. The theoretical background for the Mariner Mars 1969 relativity test is presented, including computation of orbits and time transformation. Interplanetary and coronal plasma effects on range and Doppler observations at S-band are also considered. The general relativistic propagation delay was measured and a value of 0.997 for the relativity parameter Gamma star was obtained. K.P.D.

N72-13794*# Massachusetts Inst. of Tech., Cambridge.
TESTING GENERAL RELATIVITY: PROGRESS, PROBLEMS, AND PROSPECTS **c13**
Irwin I. Shapiro *In* JPL Proc. of the Conf. on Exptl. Tests of Gravitation Theories 1 Nov. 1971 p 136-147 refs (See N72-13776 04-30)
Avail: NTIS CSCL 08N

The results from ground-based experimental testing are presented. Prospects for improving these experiments are discussed. Radar echo time delays, perihelion advance and solar oblateness, time variation of the gravitational constant, and radio wave deflection are considered. Ground-based and spacecraft techniques are compared on an accuracy vs. cost basis. K.P.D.

N72-13795*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THE EFFECTS OF RANDOM ACCELERATIONS ON ESTIMATION ACCURACY WITH APPLICATIONS TO THE MARINER 1969 RELATIVITY EXPERIMENT **c19**
D. W. Curkendall, S. G. Finley, M. W. Nead, V. J. Ondrasik, and C. L. Thornton *In its* Proc. of the Conf. on Exptl. Tests of Gravitation Theories 1 Nov. 1971 p 148-157 refs (See N72-13776 04-30)
Avail: NTIS CSCL 12A

A simple point of view is presented for establishing the relationship between a general modeling error and estimation accuracy. Tentative models are given for the random, nongravitational forces thought likely to affect the Mariner 6 and 7 spacecraft. The navigation data from these spacecraft were used to determine the relativity parameter Gamma. The effect that random accelerations have on the classical least squares filter, which assumes the accelerations do not exist, is calculated, and it is demonstrated that their presence seriously affects the estimates, particularly when an extended data arc is employed. Finally, some preliminary exploration using sequential-type filters, which attempt to model and thus ameliorate the effects of these same accelerations, is reported. Author

N72-13796*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
RADIO TRACKING WITH THE DEEP SPACE NETWORK **c07**
Warren L. Martin *In its* Proc. of the Conf. on Exptl. Tests of Gravitation Theories 1 Nov. 1971 p 158-165 refs (See N72-13776 04-30)
Avail: NTIS CSCL 17B

Range and Doppler measurements for the Mariner 6 and 7 spacecraft are described. The Doppler tracking system and the two systems of spacecraft ranging apparatus being used in the Deep Space Network are illustrated. Charged particle calibration is considered. Equipment characteristics are presented for the ranging apparatus. K.P.D.

N72-13797*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
FUTURE POSSIBILITIES IN SPACECRAFT RANGING AND DOPPLER SYSTEMS **c21**
Mahlon Easterling *In its* Proc. of the Conf. on Exptl. Tests of Gravitation Theories 1 Nov. 1971 p 166-177 ref (See N72-13776 04-30)
Avail: NTIS CSCL 17G

The structure of spacecraft tracking radar, and range and Doppler measurements, are discussed. Ranging can be used in conjunction with Doppler to determine the total number of charged particles on the radio path. Ranging can also be employed as the primary data type in determining certain kinds of orbits. The basic configuration of the ranging and Doppler system is considered. Inherent limitations on its accuracy with respect to the oscillator, transponder, ground equipment, signal to noise ratio, and general operation are noted. K.P.D.

N72-13798*# Joint Inst. for Lab. Astrophysics, Boulder, Colo.
THE LUNAR LASER RANGING EXPERIMENT **c16**
P. L. Bender, R. H. Dicke (Princeton Univ.), D. T. Wilkinson (Princeton Univ.), C. O. Alley (Maryland Univ.), D. G. Currie (Maryland Univ.), J. E. Faller (Wesleyan Univ.), J. D. Mulholland (JPL), E. C. Silverberg (McDonald Obs.), H. E. Plotkin (NASA. Goddard Space Flight Center), W. M. Kaula (Calif. Univ., Los Angeles) et al *In* JPL Proc. of the Conf. on Exptl. Tests of Gravitation Theories 1 Nov. 1971 p 178-181 refs (See N72-13776 04-30)
Avail: NTIS CSCL 20E

With data from two or more well-located observing stations, the lunar range can be corrected accurately for the effects of polar motion and fluctuations in the earth's rotation rate. Very accurate corrections can be made for the earth tides at each station. It appears that the use of lasers giving roughly 0.1-msec pulse lengths is highly desirable. With them, single-shot ranging accuracies of about 3 cm are expected. The actual lunar range results will be analyzed by fitting a numerical integration for the lunar motion to the data. A mathematical model for lunar range is given. Tests of the theory of gravitation are considered.
Author

N72-13799*# Paris Univ. (France).
THE ACCURACY OF LASER TRACKING **c16**
J. E. Blamont *In* JPL Proc. of the Conf. on Exptl. Tests of Gravitation Theories 1 Nov. 1971 p 182-189 refs (See N72-13776 04-30)
Avail: NTIS CSCL 20E

A brief discussion of the actual laser tracking performance of geodetic satellites is followed by a discussion of the errors

inherent in the laser system. An estimate is made of the capability expected within the next few years for the tracking of a heliocentric probe. The GEOS 1, GRARR, and GEOS 2 systems are considered. Errors in the tracking of a heliocentric probe are noted. These include errors due to the earth's atmosphere, (beam bending, atmospheric absorption, atmospheric turbulence, and atmospheric distortion of short laser pulses), and errors due to coronal effects. Author

N72-13800*# Stanford Univ., Calif.
DRAG-FREE SATELLITE CONTROL SYSTEM TECHNOLOGY **c21**
Daniel B. Debra *In* JPL Proc. of the Conf. on Exptl. Tests of Gravitation Theories 1 Nov. 1971 p 190-196 refs (See N72-13776 04-30)
Avail: NTIS CSCL 17G

Some of the technology developed in building a drag-free satellite simulator for laboratory use is described. The design decisions made in order to achieve a 10 to the -11th power g perturbation level for the navigation satellite is discussed. The control system development that will make possible drag-free operation of spinning satellites to reduce perturbation levels by averaging is described. Author

N72-13801*# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
PHYSICAL LIMITATIONS IN SENSORS FOR A DRAG-FREE DEEP SPACE PROBE **c14**
Remy Juillerat *In* JPL Proc. of the Conf. on Exptl. Tests of Gravitation Theories 1 Nov. 1971 p 197-212 refs (See N72-13776 04-30)
Avail: NTIS CSCL 14B

The inner perturbing forces acting on sensors were analyzed, taking into account the technological limitations imposed on the proof mass position pickup and proof mass acquisition system. The resulting perturbing accelerations are evaluated as a function of the drag-free sensor parameters. Perturbations included gravitational attraction, electrical action, magnetic action, pressure effects, radiation effects, and action of the position pickup. These data can be used to study the laws of guidance, providing an optimization of the space probe as a whole. Author

N72-13802*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
APPLICATIONS OF PRESENTLY PLANNED INTERPLANETARY MISSIONS TO TESTING GRAVITATIONAL THEORIES
L. D. Friedman *In its* Proc of the Conf. on Exptl. Tests of Gravitation Theories 1 Nov. 1971 p 213-221 refs (See N72-13776 04-30)
Avail: NTIS CSCL 22B

A summary of the probable interplanetary missions for the 1970's is presented, which may prove useful in testing the general theory of relativity. Mission characteristics are discussed, as well as instrumentation. This last includes a low-level accelerometer and S-/X-band transponders and antennas.
Author

N72-13803*# Office National d'Etudes et de Recherches Aerospatiales, Paris (France).
STUDY OF THE DETERMINATION OF THE COEFFICIENTS BETA AND GAMMA OF THE GENERALIZED METRIC OF ROBERTSON AND OF THE DYNAMICAL OBLATENESS OF THE SUN **c29**
Christian Marchal *In* JPL Proc. of the Conf. on Exptl. Tests of Gravitation Theories 1 Nov. 1971 p 222-227 refs (See N72-13776 04-30)
Avail: NTIS CSCL 03B

Motion of a space probe about a spherical center of attraction is considered, applying the general theory of relativity. Motion of a probe under the influence of the sun's oblateness is also discussed. Estimates of beta, gamma, and J20 using solar probe motion are presented. It is concluded that such measurements are possible if the unknown long-period perturbing acceleration is of the order of 10 to the -11th or -12th power m/sec. sq. K.P.D.

N72-13804*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
AN EOTVOS EXPERIMENT IN EARTH ORBIT **c13**
Philip K. Chapman (MIT) and Andrew J. Hanson (MIT) *In* JPL Proc. of the Conf. on Exptl. Tests of Gravitation Theories 1 Nov. 1971 p 228-235 refs (See N72-13776 04-30)
Avail: NTIS CSCL 03B

The gravitational interactions of mass energy stored in the weak interaction are being investigated. The magnitude of possible Eotvos anomalies, such as weak interaction, gravitational self-energy, spin-orbit interactions, and electromagnetic radiation reaction, are considered. A sensitive experiment was designed to determine whether weak interaction energy violates the equivalence principle. Factors to be considered in spacecraft design for the experiment are presented. K.P.D.

N72-13805*# European Space Research Organization, Paris (France).
ESRO STUDY PROGRAM FOR A SPACE EXPERIMENT ON GRAVITATION THEORIES **c13**
G. M. Israel *In* JPL Proc. of the Conf. on Exptl. Tests of Gravitation Theories 1 Nov. 1971 p 236-241 (See N72-13776 04-30)
Avail: NTIS CSCL 03B

ESRO is considering a space experiment which is the definition phase. A more complete utilization of space techniques, leading to highly accurate acceleration measurements in a heliocentric spacecraft, together with an improved laser signal propagation method (using a space-borne atomic clock), could substantially increase the validity of the gravitational time delay test during solar conjunction. Preliminary investigations of the primary required techniques were carried out. These studies included an orbit analysis, investigation of drag-free techniques, and studies of the time measuring instrument. These studies were used to define the framework of a space experiment on gravitation theories. A preliminary feasibility study of the mission is being undertaken. Author

N72-13806*# European Space Operations Center, Darmstadt (West Germany).
ON THE ACCURACY OF THE RELATIVISTIC PARAMETERS BETA, GAMMA, AND THE SOLAR OBLATENESS COEFFICIENT J2, AS DEDUCED FROM RANGING DATA OF A DRAG-FREE SPACE PROBE **c29**
E. A. Roth *In* JPL Proc. of the Conf. on Exptl. Tests of Gravitation Theories 1 Nov. 1971 p 242-244 refs (See N72-13776 04-30)
Avail: NTIS CSCL 03B

Motion in the general gravity field is described mathematically. A covariance analysis, based on two simple models, is presented. Two drag-free space probes were considered, for which the orbital elements are given. K.P.D.

N72-13807*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
ANCHORING SPACECRAFT TO PLANETS
D. L. Cain *In its* Proc. of the Conf. on Exptl. Tests of Gravitation Theories 1 Nov. 1971 p 244-248 refs (See N72-13776 04-30)
Avail: NTIS CSCL 22C

For planet tracking, the immense mass relative to applied nongravitational forces (for even the smaller asteroids) removes limitations on the ability to model orbital motion mathematically. A lander on a natural satellite (other than the moon) would not suffer from nongravitational effects, and would further have a large mean motion, which is important for observing gravitational effects. The tracking of a Mars lander over a long period would yield conclusions in the areas of relativity (determination of the

parameter beta), the inertial framework, Mars' internal structure (based on the polar moment), and Mars' physical ephemeris.
Author

N72-13808*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
THE USE OF THE EARTH-MOON SYSTEM AS A RADIO TRACKING FACILITY c07
J. Derral Mulholland *In its* Proc. of the Conf. on Exptl. Tests of Gravitation Theories 1 Nov. 1971 p 249-251 refs (See N72-13776 04-30)
Avail: NTIS CSCL 17B

The use of the earth-moon system for radio tracking has several potentially useful aspects, from a scientific standpoint: extension of the baseline by two orders of magnitude, absence of lunar atmosphere, higher-velocity parallax with a longer period, and the moon's more modellable rotation. The facility would be a convenient base station for other research, not directly involving the tracking capability, but utilizing its orbiting data link features.
Author

N72-13809*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
SUMMATION AND CRITIQUE
R. W. Davies *In its* Proc. of the Conf. on Exptl. Tests of Gravitation Theories 1 Nov. 1971 p 252-256 (See N72-13776 04-30)
Avail: NTIS CSCL 22C

A brief history of gravitational theory studies is presented. A discussion of the papers given at the conference follows. Possibilities for further study are noted.
K.P.D.

N72-13810*# California Inst. of Tech., Pasadena. Big Bear Solar Observatory.
MORPHOLOGICAL RELATIONSHIPS IN THE CHROMOSPHERIC H-ALPHA FINE STRUCTURE
Peter Foukal (Hale Obs.) [1971] 17 p refs
(Grants NSR-05-002-071; NSF GA-1472)
(NASA-CR-124718) Avail: NTIS CSCL 03A

A continuous relationship is proposed between the basic elements of the dark fine structure of the quiet and active chromosphere. A progression from chromospheric bushes to fibrils, then to chromospheric threads and active region filaments, and finally to diffuse quiescent filaments, is described. It is shown that the horizontal component of the field on opposite sides of an active region quiescent filament can be in the same direction and closely parallel to the filament axis. Consequently, it is unnecessary to postulate twisted or otherwise complex field configurations to reconcile the support mechanism of filaments with the observed motion along their axis.
Author

N72-13811*# California Univ., Berkeley. Space Sciences Lab.
LUNAR SURFACE ENGINEERING PROPERTIES EXPERIMENT DEFINITION. VOLUME 1: MECHANICS, PROPERTIES, AND STABILIZATION OF LUNAR SOILS
Final Report, 19 Jul. 1969 - 19 Jul. 1970
James K. Mitchell, William N. Houston, Ted S. Vinson, H. Turan Durgunoglu, Laith I. Namiq, James B. Thompson, and Donald D. Treadwell Jul. 1971 233 p refs
(Contract NAS8-21432)
(NASA-CR-121047; SSL-Ser-11-Issue-48; DCN-1-X-80-00058-S1(IF)-Vol-1) Avail: NTIS CSCL 03B

CONTENTS:
1. PREFACE p iii
2. LUNAR SOIL SIMULTANT STUDIES W. N. Houston, L. I. Namiq, J. K. Mitchell, and D. D. Treadwell 110 p refs (See N72-13812 04-30)
3. DETERMINATION OF IN SITU SOIL PROPERTIES UTILIZING AN IMPACT PENETROMETER J. B. Thompson and J. K. Mitchell 78 p refs (See N72-13813 04-30)
4. LUNAR SOIL STABILIZATION USING URETHANE FOAMED PLASTICS T. S. Vinson, H. T. Durgunoglu, and J. K. Mitchell 22 p refs (See N72-13814 04-30)
5. FEASIBILITY STUDY OF ADMIXTURE SOIL STABILIZATION WITH PHENOLIC RESINS H. T. Durgunoglu and J. K. Mitchell 13 p refs (See N72-13815 04-13)

N72-13812*# California Univ., Berkeley.
LUNAR SOIL SIMULANT STUDIES
William N. Houston, Laith I. Namiq, James K. Mitchell, and Donald D. Treadwell *In its* Lunar Surface Eng. Properties Expt. Definition, Vol. 1 Jul. 1971 110 p refs (See N72-13811 04-30)
Avail: NTIS CSCL 03B

To represent the actual lunar soil as revealed by the Apollo 11 and 12 missions, the lunar soil simulant used in previous studies was modified. Special emphasis was placed on the determination of stress-strain, strength, compressibility, and trafficability parameters and their variations with density. Stress-deformation characteristics were determined through plate-load, boot-imprint, and penetrometer tests. The lunar soil simulant was also used in feasibility studies for several simple geotechnical tests, which were proposed for later Apollo missions. These include penetrometer tests, plate load tests, trenching, and core tube sampling. The results of these studies with the lunar soil simulant are being used as a basis for recommendations for modification of existing Apollo hand tools and for the design of new devices for the in situ study of lunar surface materials.
Author

N72-13813*# California Univ., Berkeley.
DETERMINATION OF IN SITU SOIL PROPERTIES UTILIZING AN IMPACT PENETROMETER
James B. Thompson and James K. Mitchell *In its* Lunar Surface Eng. Properties Expt. Definition, Vol. 1 Jul. 1971 78 p refs (See N72-13811 04-30)
Avail: NTIS CSCL 03B

The use of impact penetration testing of determining remotely lunar soil properties is investigated. A detailed summary of a literature review on impact penetration is given, and the feasibility of approaching the problem theoretically is evaluated. The existing empirical analytical expressions relating the dependent and independent variables of the impact penetration problem is examined. Emphasis is on an evaluation of the relative and absolute merits of these expressions and the determination of probable independent variables requiring additional experimental investigation to allow extrapolation of terrestrial test results to the lunar environment. An experimental program was designed, and a conceptual design of all equipment necessary for conducting the testing is completed.
Author

N72-13814*# California Univ., Berkeley.
LUNAR SOIL STABILIZATION USING URETHANE FOAMED PLASTICS
Ted S. Vinson, H. Turan Burgunoglu, and James K. Mitchell *In its* Lunar Surface Eng. Properties Expt. Definition, Vol. 1 Jul. 1971 22 p refs (See N72-13811 04-30)
Avail: NTIS CSCL 03B

The emphasis in lunar soil stabilization studies was on soil grouting and results indicate that grouting of fragmented rock masses or coarse-grained soil masses using urethane foamed plastic should be possible. Urethane systems were developed that cause such masses to have high unconfined compressive strengths. The use of urethane or other foamed plastics as admixture lunar soil stabilizing agents was also investigated, and may represent a realistic approach for stabilizing fine-grained deposits. An attempt was made to develop a urethane foam system for lunar pour or spray-on applications.
Author

N72-13815*# California Univ., Berkeley.
FEASIBILITY STUDY OF ADMIXTURE SOIL STABILIZATION WITH PHENOLIC RESINS c13
H. Turan Durgunoglu and James K. Mitchell *In its* Lunar Surface

Eng. Properties Expt. Definition, Vol. 1 Jul. 1971 13 p refs (See N72-13811 04-30)
Avail: NTIS CSCL 08M

The possibility of using phenolic resins as less expensive chemicals than urethanes for lunar soil stabilizing agents was studied. The chemistry of resin systems, controlling factors of reactions, and the effects of different factors on curing were also investigated. Several systems were developed which appear to offer some potential for stabilization. Soils treated with these materials, however, were not satisfactorily stabilized, probably due to the inclusion of large amounts of water. It is felt powder resins should be investigated. Author

N72-13816*# California Univ., Berkeley. Space Sciences Lab.
LUNAR SURFACE ENGINEERING PROPERTIES EXPERIMENT DEFINITION. VOLUME 2: MECHANICS OF ROLLING SPHERE-SOIL SLOPE INTERACTION Final Report, 19 Jul. 1969 - 19 Jul. 1970
H. John Hovland and James K. Mitchell Jul. 1971 245 p refs (Contract NAS8-21432)
(NASA-CR-121045; SSL-Ser-11-Issue-49; DCN-1-X-80-00058-S1(IF)-Vol-2) Avail: NTIS CSCL 03B

The soil deformation mode under the action of a rolling sphere (boulder) was determined, and a theory based on actual soil failure mechanism was developed which provides a remote reconnaissance technique for study of soil conditions using boulder track observations. The failure mechanism was investigated by using models and by testing an instrumented spherical wheel. The wheel was specifically designed to measure contact pressure, but it also provided information on the failure mechanism. Further tests included rolling some 200 spheres down sand slopes. Films were taken of the rolling spheres, and the tracks were measured. Implications of the results and reevaluation of the lunar boulder tracks are discussed. Author

N72-13817*# California Univ., Berkeley. Space Sciences Lab.
LUNAR SURFACE ENGINEERING PROPERTIES EXPERIMENT DEFINITION. VOLUME 3: BOREHOLE PROBES Final Report, 19 Jul. 1969 - 19 Jul. 1970
Richard E. Goodman, Karel Drozd, Suphon Chirapuntu, H. John Hovland, and Tran K. Van Jul. 1971 86 p refs
(Contract NAS8-21432)
(NASA-CR-121046; SSL-Ser-11-Issue-50; DCN-1-X-80-00058-S1(IF)-Vol-3) Avail: NTIS CSCL 03B

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1. PREFACE p iii
2. BOREHOLE PROBES: SUMMARY OF PREVIOUS WORK R. E. Goodman, T. K. Van, and K. Drozd 14 p refs (See N72-13818 04-30)
3. AN EXPERIMENTAL STUDY OF THE MECHANISM OF FAILURE OF ROCKS UNDER BOREHOLE JACK LOADING T. K. Van and R. E. Goodman 36 p refs (See N72-13819 04-13)
4. A BOREHOLE JACK FOR DEFORMABILITY, STRENGTH, AND STRESS MEASUREMENTS IN A 2-INCH BOREHOLE R. E. Goodman, H. J. Hovland, and S. Chirapuntu 28 p refs (See N72-13820 04-13)

N72-13818*# California Univ., Berkeley.
BOREHOLE PROBES: SUMMARY OF PREVIOUS WORK
Richard E. Goodman, Tran K. Van, and Karel Drozd *In its* Lunar Surface Eng. Properties Expt. Definition, Vol. 3 Jul. 1971 14 p refs (See N72-13817 04-30)
Avail: NTIS CSCL 03B

Previous research explored the applicability of some devices to lunar borehold testing and, in particular, examined the use of such instruments to assess the strength of soils and rocks. Special attention was given to borehole jacks, which essentially conduct a plate bearing test across opposing wall areas. Analytical work employed finite element analysis, the theory of plasticity, and the theory of elasticity using the complex variable method. A number of solutions were reached for tractable subproblems in the set of problems posed when a jack is used to expand sectors of a borehole. In addition, an investigation with physical models was made to explore the modes of behavior for varying boundary conditions and materials, including both elastic and plastic media. Author

N72-13819*# California Univ., Berkeley.
AN EXPERIMENTAL STUDY OF THE MECHANISM OF FAILURE OF ROCKS UNDER BOREHOLE JACK LOADING c13
Tran K. Van and Richard E. Goodman *In its* Lunar Surface Eng. Properties Expt. Definition, Vol. 3 Jul. 1971 36 p refs (See N72-13817 04-30)
Avail: NTIS CSCL 08M

Laboratory and field tests with an experimental jack and an NX-borehole jack are reported. The following conclusions were made: Under borehole jack loading, a circular opening in a brittle solid fails by tensile fracturing when the bearing plate width is not too small. Two proposed contact stress distributions can explain the mechanism of tensile fracturing. The contact stress distribution factor is a material property which can be determined experimentally. The borehole tensile strength is larger than the rupture flexural strength. Knowing the magnitude and orientation of the in situ stress field, borehole jack test results can be used to determine the borehole tensile strength. Knowing the orientation of the in situ stress field and the flexural strength of the rock substance, the magnitude of the in situ stress components can be calculated. The detection of very small cracks is essential for the accurate determination of the failure loads which are used in the calculation of strengths and stress components. Author

N72-13820*# California Univ., Berkeley.
A BOREHOLE JACK FOR DEFORMABILITY, STRENGTH, AND STRESS MEASUREMENTS IN A 2-INCH BOREHOLE c13
Richard E. Goodman, H. John Hovland, and Suphon Chirapuntu *In its* Lunar Surface Eng. Properties Expt. Definition, Vol. 3 Jul. 1971 28 p refs (See N72-13817 04-30)
Avail: NTIS CSCL 08M

A borehole jack devised for lunar exploration is described and results of its use in simulated lunar solids are presented. A hydraulic cylinder mounted between two stiff plates acts to spread the plates apart against the borehole walls when pressured. The spreading is measured by a displacement transducer and the load is measured hydraulically. The main improvement over previous instruments is the increased stroke, which allows large deformations of the borehole. Twenty-eight pistons are used to obtain a high hydraulic efficiency, and three return pistons are also provided. Pressure-deformation curves were obtained for each test on Lunar Soil Simulant No. 2, a light gray silty basalt powder. Author

N72-13821*# California Univ., Berkeley. Space Sciences Lab.
LUNAR SURFACE ENGINEERING PROPERTIES EXPERIMENT DEFINITION. VOLUME 4: FLUID CONDUCTIVITY OF LUNAR SURFACE MATERIALS Final Report, 19 Jul. 1969 - 19 Jul. 1970
Franklin C. Hurlbut, D. Roger Willis, Paul A. Witherspoon, C. Robert Jih, and Parabaronen Raghuraman Jul. 1971 61 p refs (Contract NAS8-21432)
(NASA-CR-121044; SSL-Ser-11-Issue-51; DCN-1-X-80-00058-S1(IF)-Vol-4) Avail: NTIS CSCL 03B

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1. PERFACE p iii
2. STUDIES ON FLUID CONDUCTIVITY OF LUNAR SURFACE MATERIALS: THEORETICAL STUDIES P. Raghuraman and D. R. Willis 43 p (See N72-13822 04-30)
3. STUDIES ON FLUID CONDUCTIVITY OF LUNAR SURFACE MATERIALS: EXPERIMENTAL STUDIES F. C. Hurlbut, C. R. Jih, and P. A. Witherspoon 11 p (See N72-13823 04-30)

N72-13822*# California Univ., Berkeley.
STUDIES ON FLUID CONDUCTIVITY OF LUNAR SURFACE MATERIALS: THEORETICAL STUDIES
Parabaronen Raghuraman and D. Roger Willis *In its* Lunar Surface Eng. Properties Expt. Definition, Vol. 4 Jul. 1971 43 p (See N72-13821 04-30)
Avail: NTIS CSCL 03B

Two studies on the development of a probe for measuring fluid conductivity bf porous media under lunar conditions are reported. A reasonable estimate of the time to establish steady state conditions appears necessary. The effect is considered of dead end pores, which initially contain essentially no gas and act for some time as sinks for mass flow, when gas first flows down the main (through) pores. A truly steady flow cannot be established before there is pressure equilibrium between the dead end pore and the open pore. The influence of the wength-to-radius ratio on the time constant for filling up to the dead end pores in the free molecular limit is considered. In the second study, the degree of sophistication necessary to analyze the flow through a porous media with vacuum as one boundary condition is examined. The flow, in general, would contain an initial region of contiuum flow which would undergo a gradual transition to free molecular flow. To obtain rough estimates, a sudden freeze model is proposed. Author

N72-13823*# California Univ., Berkeley.
STUDIES ON FLUID CONDUCTIVITY OF LUNAR SURFACE MATERIALS: EXPERIMENTAL STUDIES
Franklin C. Hurlbut, C. Robert Jih, and Paul A. Witherspoon *In its* Lunar Surface Eng. Properties Expt. Definition, Vol. 4 Jul. 1971 11 p refs (See N72-13821 04-30)
Avail: NTIS CSCL 03B

The design of the permeability probe for studying fluid flows in porous media under rarefied gas flow conditions is described, and preliminary observations are discussed. The apparatus consists of a gas source and flow metering system, a specimen chamber with pressure taps distributed along its length, a pressure transducer and metering system, a high capacity vacuum pump, valves, ancillary gages, and pumps. For initial performance testing, cast concrete specimens were prepared and their permeabilities were determined. From the preliminary measurements, the apparatus appears to have the capability of giving results of the quality desired. Author

N72-13824*# California Univ., Berkeley. Space Sciences Lab.
LUNAR SURFACE ENGINEERING PROPERTIES EXPERIMENT DEFINITION Summary Technical Report, 19 Jul. 1969 - 19 Jul. 1970
James K. Mitchell, Richard E. Goodman, Franklin C. Hurlbut, William N. Houston, D. Roger Willis, Paul A. Witherspoon, and H. John Hovland Jul. 1971 46 p refs
(Contract NAS8-21432)
(NASA-CR-121043; SSL-Ser-11-Issue-52;
DCN-1-X-80-00058-S1(IF)-Sum-TR) Avail: NTIS CSCL 03B

Research on the mechanics of lunar soils and on developing probes to determine the properties of lunar surface materials is summarized. The areas of investigation include the following: soil simulation, soil property determination using an impact penetrometer, soil stabilization using urethane foam or phenolic resin, effects of rolling boulders down lunar slopes, design of borehole jack and its use in determining failure mechanisms and properties of rocks, and development of a permeability probe for measuring fluid flow through porous lunar surface materials.
N.E.N.

N72-13825*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
AN ANALYSIS AND COMPARISON OF SEVERAL TRAJECTORY OPTIMIZATION METHODS
J. M. Lewallen [Nov. 1971] 252 p refs
(NASA-TM-X-58065) Avail: NTIS CSCL 22A

The sensitivities of the convergence characteristics of the methods to initially assumed parameters and trial solution, convergence times, computer logic, and storage requirements are discussed. Numerical comparison of the convergence characteristics is made by considering a minimum time, low thrust, Earth-Mars transfer trajectory. A modified quasi-linearization method reduces convergence time by approximately 70% when compared with the generalized Newton-Raphson method and allows the terminal boundary to be specified by a general function of the problem variables. A uniquely specified and easily determined, time dependent weighting matrix for the gradient techniques accelerates the shaping of the optimal control program and improves the convergence characteristics during the terminal iterations. Convergence envelopes, indicating how sensitive the convergence characteristics are to initially assumed parameters, are plotted for the perturbation and quasi-linearization methods. Several iteration schemes are proposed which increase the size of the convergence envelopes and decrease the sensitivity of the method to initially assumed parameters.
Author

N72-13826*# California Univ., Berkeley. Space Sciences Lab.
NUCLEAR TRACKS IN LUNAR SAMPLES Final Scientific Report
P. B. Price Nov. 1971 64 p refs
(Contract NAS9-10488)
(NASA-CR-115266) Avail: NTIS CSCL 03B

An attempt is made to relate the appearance of an etched tract to the atomic number and velocity of the ion that left it using 10 MeV/nucleon Kr beams and 6 MeV/nucleon Zn beams. It was found that the etching rate along a tract in minerals and glass is a monototonic function of ionization rate thus, making particle identification possible. Results show the following were present in lunar samples: superheavy elements, cosmic rays with z greater than 26, and solar flare particles in Surveyor glass. E.H.W.

N72-13827# Joint Publications Research Service, Washington, D.C.
OBSERVATIONS OF ARTIFICAL EARTH SATELLITES AT UZHGOROD
M. V. Bratiychuk 22 Dec. 1971 5 p Transl. into ENGLISH from Zemlya Vselennaya (Moscow), no. 4, 1971 p 48-51
(JPRS-54766) Avail: NTIS

Satellite tracking activities at the Uzhgorod State University observatory are briefly discussed. Visual observations are conducted by students, and the training program is mentioned. The photographic equipment and type of data obtained are described, and the importance of synchronous observations of active and passive objects for solving applied problems in geodesy is indicated. The distortion in light propagation caused by turbulent air streams is determined, and solar and comet observations are mentioned. N.E.N. qr

N72-13828*# GCA Technology Div., GCA Corp., Bedford, Mass. Technology Div.
A STUDY OF PLANETARY METEOROLOGY Quarterly Progress Report, 1 Jul. - 30 Sep. 1971
George Ohring 20 Oct. 1971 22 p refs
(Contract NASw-2221)
(QPR-2) Avail: NTIS CSCL 03B

The concept is described of deducing the temperature profile of a planetary atmosphere from orbiter measurements of the planet's IR limb radiance profile. Expressions are derived for the weighting functions associated with the limb radiance profile for two infrared tranmission models. Analysis of the weighting functions for the Martian atmosphere indicates that a limb radiance profile in the 15 micron CO2 band can be used to determine the Martian atmospheric temperature profile from 20 to 60 km. Author

N72-13829*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
CELESTIAL ORBIT DELIVERY AND RECOVERY SYSTEM

WITH REUSABLE UNMANNED UPPER STAGE Patent Application
Raymond H. Bradley, inventor (to NASA) Filed 14 Jan. 1965 12 p
(NASA-Case-MSC-12391-1; US-Patent-Appl-SN-106465) Avail: NTIS CSCL 22A

A space shuttle system for delivering payload to earth orbit or other celestial orbit comprising a specially designed stage is described to be used with the orbiter and booster of the space shuttle. The booster can carry either the orbiter or the stage to a suborbital staging point. Both the orbiter and the stage are capable of proceeding from such a staging point to celestial orbit carrying a payload. The orbiter, having reentry equipment, is capable of reentering the earth's atmosphere and landing on earth. The orbiter has a reentry environment protected bay in which its payload can be carried. The stage, being independent of reentry equipment, has a large payload carrying compartment and a smaller, detachable subsystem carrying portion which can be received into and carried back to earth in the protected payload bay of the orbiter. NASA

N72-13830*# Bureau of Mines, Spokane, Wash. Mining Research Center.
GRAVITY FLOW OF POWDER IN A LUNAR ENVIRONMENT. PART 2: ANALYSIS OF FLOW INITIATION
William G. Pariseau 1971 22 p refs
(NASA Order R-09-040-001)
(NASA-CR-124812; TN23.U7-NO-7577; Dewey-7577; LC-622.06173; BM-RI-7577-Pt-2) Avail: NTIS CSCL 03B

A small displacement-small strain finite element technique utilizing the constant strain triangle and incremental constitutive equations for elasticplastic (media nonhardening and obeying a Coulomb yield condition) was applied to the analysis of gravity flow initiation. This was done in a V-shaped hopper containing a powder under lunar environmental conditions. Three methods of loading were examined. Of the three, the method of computing the initial state of stress in a filled hopper prior to drawdown, by adding material to the hopper layer by layer, was the best. Results of the analysis of a typical hopper problem show that the initial state of stress, the elastic moduli, and the strength parameters have an important influence on material response subsequent to the opening of the hopper outlet. Author

N72-13831# Grumman Aerospace Corp., Bethpage, N.Y. Research Dept.
THE EVOLUTION OF WATER VAPOR IN THE ATMOSPHERE OF VENUS
Lewis L. Smith and Stanley H. Gross (Polytech. Inst. of Brooklyn) Nov. 1971 29 p refs Submitted for publication
(RE-417J) Avail: NTIS

The atmosphere of Venus appears to be deficient in water vapor by a factor of about 10,000 compared with the total amount of water on the earth. The feasibility of water vapor loss from the Venus atmosphere is examined, assuming H2O as the sole initial constituent. A steady state model is constructed, and the photochemistry establishes the distribution of important products in the upper atmosphere. Calculations bf exospheric temperature yield values as high as 100,000 K. Such large temperatures result from the large abundance of atomic hydrogen in the exosphere, and imply a dynamic outflow of all constituents from the upper region of the atmosphere. Such an outflow would cause the escape of all hydrogen and some of the oxygen resulting from dissociation of H2O. Little loss of CO2 would result due to its low abundance in the upper region, permitting its accumulation to the present observed value. It is concluded that if Venus formed from the same mix of materials as the earth, much tectonic activity and fairly rapid outgassing must have occurred during the early phase of its history to account for the loss of water vapor. Author

N72-13832*# National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.
LUNAR RILLES: A CATALOG AND METHOD OF CLASSIFICATION
V. R. Oberbeck, Ronald Greeley (Santa Clara Univ.), Robert B. Morgan, and Michael J. Lovas Nov. 1971 83 p
(NASA-TM-X-62088) Avail: NTIS CSCL 03B

A representative sample of lunar rilles observed on Lunar Orbiter 4 and 5 photographs is presented. A method of classification of rilles is described which will provide a means of quantitatively grouping rilles of similar planemetric shape. The method is based on a finite Fourier approximation of the edge of the rille. It provides an adequate approximation to all planemetric characteristics of the rille except rille recurvature. Author

N72-13833# Pennsylvania Univ., Philadelphia.
A CATALOG OF GRADED PHOTOMETRIC STUDIES OF CLOSE BINARIES
Robert Harry Koch, Mirek Plavec (Czechoslovak Acad. of Sci., Ondrejov), and Frank Bradshaw Wood (Florida Univ.) 1970 111 p refs Sponsored in part by NSF
(Astron-Ser-Vol-11) Avail: NTIS

Tabular material in this catalog was obtained by numerical weighting of close binaries' light curve parameters. All solutions rest upon measures of one of the following types: photoemissive or photoconductive observations, microphotometry of extra-focal photographic images, or visual observations with any of the calibrated types of polarizing, wedge, to other objective photometers. A net weight, commonly the arithmetic average, of the three characteristics was then assigned each observational series for a binary. Photometric solutions for 88 close binaries were tabulated. G.G.

N72-13834*# National Aeronautics and Space Administration, Washington, D.C.
ENVIRONMENTAL STATEMENT FOR APPLICATIONS TECHNOLOGY SATELLITE PROGRAM
31 Mar. 1971 12 p refs
(NASA-TM-X-67464; PB-199460-D) Avail: NTIS CSCL 22A

The experiments, environmental impact, and applications of data collected by ATS are discussed. Data cover communications, navigation, meteorology, data collection (including data from small unattended remote stations such as buoys, seismology and hydrology monitors, etc.), geodesy, and scientific experiments to define the environment at synchronous orbit, and to monitor emissions from the sun. Author

N72-13835*# Princeton Univ. Observatory, N.J.
VELOCITY DISPERSIONS IN GALAXIES: 1: THE SO GALAXY NGC 7332
Donald C. Morton and Roger A. Chevalier [1971] 24 p refs
(Grant NSR-31-001-127)
(NASA-CR-124811) Avail: NTIS CSCL 03A

A Coude spectrum of the SO galaxy NGC 7332 with 0.9 A resolution from 4186 to 4364 A was obtained with the SEC vidicon television camera and the Hale telescope. Comparisons with spectra of G and K giant stars, numerically broadened for various Maxwellian velocity distributions, give a dispersion velocity in the line of sight of 160 + or - 20 km/sec with the best fit at G8III. The dispersion appears to be constant within + or - 35 km/sec out to 1.4 kpc (H = 100 km/sec/mpc). After correction for projection, the rotation curve has a slope of 0.16 km/sec/pc at the center and a velocity of 130 km/sec at 1.4 kpc where it is still increasing. For an estimated effective radius of 3.5 kpc enclosing half the light, the virial theorem gives a mass of 1.4 x 10 to the 11th power solar masses if the mass-to-light ratio is constant throughout the galaxy. The photographic luminosity is 8.3 x 10 to the 9th power solar luminosities so that the M/L ratio is 17. Author

N72-13836*# California Univ., Berkeley. Dept. of Physics.
ISOTOPIC STUDIES IN RETURNED LUNAR SAMPLES Final Report, 1 Aug. 1969 - 31 Jan. 1971
E. C. Alexander, Jr. Jan. 1971 82 p refs
(Contract NAS9-9949)

(NASA-CR-115305) Avail: NTIS CSCL 03B

Analysis of lunar soil samples returned by Apollo 11 and 12 flights are discussed. Isotopic studies of the rare gases from Apollo 11 flight lunar samples are presented. The lunar soil analyses indicated the following: (1) high concentrations of solar wind rare gases, (2) isotopic match between solar wind gases and gas components in gas-rich meteorites, and (3) rare gases attributable to spallation reactions induced in heavier nuclides by cosmic ray particles. Author

N72-13837*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

EFFECT OF ENVIRONMENTAL TORQUES ON SHORT-TERM ATTITUDE PREDICTION FOR A ROLLING-WHEEL SPACECRAFT IN A SUN-SYNCHRONOUS ORBIT

Ward F. Hodge Washington Jan. 1972 53 p refs

(NASA-TN-D-6583; L-7359) Avail: NTIS CSCL 22A

A numerical evaluation and an analysis of the effects of environmental disturbance torques on the attitude of a hexagonal cylinder rolling wheel spacecraft were performed. The resulting perturbations caused by five such torques were found to be very small and exhibited linearity such that linearized equations of motion yielded accurate results over short periods and the separate perturbations contributed by each torque were additive in the sense of superposition. Linearity of the torque perturbations was not affected by moderate system design changes and persisted for torque-to-angular momentum ratios up to 100 times the nominal expected value. As these conditions include many possible applications, similar linear behavior might be anticipated for other rolling-wheel spacecraft. Author

N72-13838*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.

A SUBORBITAL ABORT GUIDANCE SCHEME FOR ORBITAL RETURNS TO THE LAUNCH SITE

W. R. Lacy 30 Jun. 1971 52 p refs

(NASA-TM-X-67445; MSC-04466; MSC-IN-71-FM-251) Avail: NTIS CSCL 22A

A suborbital abort guidance scheme is presented for returning the orbiter vehicle to the launch site in the event of a booster malfunction. The guidance scheme described, referred to as FBGUID, represents a simple closed-form technique to the flyback abort problem. In addition to returning to the launch site, objectives of the formulation are to preclude excessive structural and heating loads. A demonstration of the feasibility of this abort guidance concept is included for a 150-second abort time.

Author

N72-13839*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.

MICROPROBE ANALYSES OF GLASSES AND MINERALS FROM LUNA-16 SOIL

R. W. Brown, R. S. Harmon, P. Jakes, A. M. Reid, W. I. Ridley, and J. L. Warner Dec. 1971 129 p refs

(NASA-TM-X-58082) Avail: NTIS CSCL 11D

Electron microprobe analyses are presented for nine elements in 250 glasses and 434 pyroxenes, eight elements in 113 olivines, and six elements in 354 feldspars, 35 spinels, and 159 ilmenites. All grains are from the 125-425 micron fraction of horizon A and horizon D soil from the Luna 16 sample. A norm is presented for each glass analysis and the structural formula is calculated for each mineral analysis. Author

N72-13840*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.

ROUND TRIP LANDING MISSIONS TO THE ASTEROID EROS, 1981 OPPORTUNITY

Gregory A. Zambo 8 Jun. 1971 24 p

(NASA-TM-X-67444; MSC-IN-71-FM-197; MSC-04334) Avail: NTIS CSCL 22A

A comprehensive, Del V (magnitude of impulsive velocity-change vector) study of short staytime (0 to 30 days), short total trip time (10 to 160 days) round trip landing missions (fast missions) is presented. The characteristics of the following selected round trip landing missions are described: mission A (fast mission) with 120-day total trip time, 0-day stay-time, and 73,000-fps total mission Del V; mission B (opposition class) with 380-day total trip time, 0-day staytime, and 52,000-fps total mission Del V; and mission C (conjuction class) with 540-day total trip time, 175-day staytime, and 39,000-fps total mission Del V. A study of large-tank Agena, chemical propulsion stage (CPS), and nuclear stage was conducted. A payload of 5000 pounds was assumed. The propulsion requirements for mission A were found to be two large-tank Agenas and ten CPSs (or alternatively, two large-tank Agenas and five nuclear stages) while mission B required two large-tank Agenas and two CPSs. Mission C can be performed with one large-tank Agena and one CPS. Author

N72-13841*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.

SKYLAB RTCC MASS PROPERTIES SYSTEM REQUIREMENTS

E. Ray Hischke 14 Jun. 1971 8 p

(NASA-TM-X-67442; MSC-04378; MSC-IN-71-FM-214) Avail: NTIS CSCL 22A

The computation equations and flow charts are presented for the Real Time Computer Complex mass properties system for computing and maintaining weight and centers of gravity for the CSM and orbital assembly, and SPS engine trim angles. N.E.N.

N72-13842*# Massachusetts Inst. of Tech., Cambridge.

PRODUCTION OF GAMMA RAYS IN THE CRAB NEBULA PULSAR

Aldo Treves (Milan Univ.) Dec. 1970 14 p refs Submitted for publication Sponsored jointly by ESRO and NASA

(NASA-CR-124833) Avail: NTIS CSCL 03A

The gamma-ray flux at energies above 50 MeV from NP0532 is evaluated for a pulsar model in which the optical and X-radiation is produced by synchrotron effect. Synchrotron radiation and inverse Compton scattering are considered as production mechanisms of the gamma-rays. The theoretical estimates are compared with the experimental values.

Author (ESRO)

N72-13843*# Massachusetts Inst. of Tech., Cambridge.

IMPORTANCE OF PULSAR OBSERVATIONS FOR PLANETARY PHYSICS

A. Treves (Milan Univ.) 1971 9 p refs Submitted for publication Sponsored in part by ESRO and NASA

(Contract AT(30-1)-3980)

(NASA-CR-124829) Avail: NTIS CSCL 03B

The possibility of observing the planetary systems of pulsars is examined. The expected perturbation in the time of arrival of pulses is computed and the detectability is discussed. ESRO

N72-13844*# Massachusetts Inst. of Tech., Cambridge.

CLASSIFICATION OF RADIATING COMPACT STARS

B. Coppi and A. Treves (Milan Univ.) 1971 16 p refs Submitted for publication Sponsored jointly by ESRO and NASA

(NASA-CR-124831) Avail: NTIS CSCL 03A

A classification of compact stars, depending on the electron distribution in velocity space and the density profiles characterizing their magnetospheric plasma, is proposed. Fast pulsars, such as NP 0532, X-ray sources such as Sco-X1, and slow pulsars are suggested as possible evolutionary stages of similar objects. The heating mechanism of Sco-X1 is discussed in some detail.

Author (ESRO)

N72-13845*# Princeton Univ. Observatory, N.J.

CONCERNING THE ORIGIN OF NOVAE AND U GEMINORUM STARS

G. T. Bath 1971 29 p refs Submitted for publication

Sponsored jointly by Sci. Res. Council, ESRO, and NASA
(NASA-CR-124830) Avail: NTIS CSCL 03A

The dynamical stability of the contact component in a semi-detached binary system is investigated by a linear time dependent analysis. The boundary condition imposed on the photosphere by the Roche lobe is assumed to be one of constant pressure over the whole surface of the lobe, which is treated as being spherically symmetric. The eigenvalues of the linear equation of motion are evaluated for sequences of stellar envelope models under the constraint of this boundary condition. An extensive region in the Hertzprung-Russell diagram is found to be dynamically unstable. This region coincides almost precisely with that predicted by a previous quasi-static study. Time scales for the growth of the instability are also evaluated. Color observations of several novae and U Geminorum stars are discussed in an attempt to provide semi-empirical tests of the proposed theoretical model of the outbursts. In particular the track in the H-R diagram of the U Geminorum star, EM Cygni, is shown to be consistent with an outburst which is purely a temperature change at constant radius, as is demanded by the theory. Author (ESRO)

N72-13846# Academy of Sciences (USSR), Moscow. Inst. for Space Research.
FLIGHT VEHICLES IN THE VENUS ATMOSPHERE
L. N. Lupichev, G. M. Moskalenko, and Y. K. Hodarev 1970 45 p refs
(D-52) Avail: NTIS

Some configurations of vehicles for flying in the Venus atmosphere are considered and classified according to various parameters such as: (1) the payload capability, (2)range velocity, and (3) flight altitude. The flight performance of the vehicles are divided in three groups. Base vehicles, deep flight ehicles, and excursion vehicles are compared. ESRO

N72-13847# European Space Research Inst., Frascati (Italy).
ON INFERRING ELASTIC PROPERTIES OF DEEP PLANETARY INTERIORS: MOON AND MARS
George H. A. Cole (Hull Univ., Engl.) [1971] 46 p refs Submitted for publication
Avail: NTIS

The planet is represented as a spherical body with a crust enclosing an interior in hydrostatic equilibrium. The interior is composed of a mantle enclosing an iron core, the radius of which is regarded as a parameter of the theory. The equations of equilibrium for the interior are arranged into a form which expresses variables in terms of a parameter Theta sub B involving the mass of the interior, its radius, and the bulk modulus at zero pressure. The parameter Theta sub B is determined by the measured moment of inertia, and the bulk modulus for the mantle material is calculated. It is found possible, on the basis of the present model, for the moon to have an iron core with a maximum radius slightly less than one tenth the total lunar radius; for Mars the core radius could be slightly more than one third the total Martian radius. The present model is also applied to the Earth as a test, and provides data in satisfactory agreement with that already available by alternative refined methods. Author (ESRO)

N72-13848# RCA International Service Corp., Patrick AFB, Fla.
AUTOMATIC MULTISATELLITE EPHEMERIS MAINTENANCE
James A. Ward, Jr. Patrick AFB, Fla. AFETR Aug. 1971 83 p refs
(Contracts F08606-68-C-0040; PAA-Subcontract-71-0040-01)
(AD-728729; AFETR-TR-71-1) Avail: NTIS CSCL 22/3

The mathematical procedures used in the Computer Automatic Scheduling System (CASS) Program are described. This program was designed for automatic multisatellite ephemeris maintenance at the Real Time Computer System on the Air Force Eastern Test Range; and is based principally on the ability of mean elements and their rates of change to describe the motion of a satellite. Objects whose ephemerides are to be maintained are restricted to those in stable non-equatorial elliptical orbits. Each pass of radar data is processed to produce a mean element vector by a non-linear orbit determination procedure. The mean element vectors representing the various passes are combined by polynomial fits and analytical computation to generate a multi-pass orbital solution for each object. This document reflects the configuration of the CASS Program as of October 1970. Author (GRA)

N72-13950# Royal Swedish Academy of Engineering Sciences, Stockholm.
STUDY OF THE RESULTS OF THE MOON SHOTS
In its Develop. in Res. and Technol. during 1970 1970 p 72-81 refs In SWEDISH (See N72-13942 04-34)
Avail: NTIS; Almqvist & Wiksell, Stockholm: 25 Kr

31 SPACE VEHICLES

Includes launch vehicles; manned space capsules; clustered and multistage rockets; satellites; sounding rockets and probes; and operating problems. For basic research see: 30 Space Sciences. For related information see also: 28 Propulsion Systems; and 32 Structural Mechanics.

N72-13849 National Lending Library for Science and Technology, Boston Spa (England).
YANTAR, A FLYING ACCELERATOR
Victor Latyshev 21 Apr. 1971 4 p Transl. into ENGLISH from Grazhdanskaya Aviats. (Moscow), no. 3, 21 Apr. 1971
(NLL-M-20868-(5828.4F); NLL-117H3806/B) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

Yantar which is a flying vehicle with an electric jet engine for flights at altitudes from 50 to 200 km is discussed as a flying accelerator. It is shown that there are no limits to the speed of the flux of particles shooting out of the flying accelerator. It is concluded that the flying accelerator is the first step in a new era of aviation: the era of the electric engines. F.O.S.

N72-13850*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
APOLLO 15 30-DAY FAILURE AND ANOMALY LISTING REPORT
Oct. 1971 80 p
(NASA-TM-X-67439; MSC-04822) Avail: NTIS CSCL 22B

The significant anomalies that occurred during the Apollo 15 mission are discussed. The five major areas are command and service modules, lunar module, scientific instrument module experiments, Apollo lunar surface experiment package and associated equipment, and government furnished equipment. Author

N72-13851*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
EREP USERS HANDBOOK
Mar. 1971 379 p refs Revised
(NASA-TM-X-67462; NASA-S-71-13209-F-Rev) Avail: NTIS HC $6.00/MF $0.95 CSCL 22B

Revised Skylab spacecraft, experiments, and mission planning information is presented for the Earth Resources Experiment Package (EREP) users. The major hardware elements and the medical, scientific, engineering, technology and earth resources experiments are described. Ground truth measurements and EREP data handling procedures are discussed. The mission profile, flight planning, crew activities, and aircraft support are also outlined. N.E.N.

N72-13852# Royal Aircraft Establishment, Farnborough (England).
RECOVERY SYSTEM FOR SOUNDING ROCKETS
R. P. Flores Jun. 1971 25 p refs Transl. into ENGLISH of "Sistema de Recuperacion de Cohetes Sondas", Comision Nacl. de Invest. Espaciales, Argentina, Contract Report 4
(RAE-LIB-TRANS-1567; BR27167; Rept-4) Avail: NTIS

After reviewing the possible methods of data recovery from sounding rockets, details are given for separating the rocket recording system from the body and returning it to earth by parachute. The theoretical calculations of powder charge and pressures required to give satisfactory operation are included. Author

N72-13853*# Jet Propulsion Lab., Calif. Inst. of Tech., Pasadena.
MARINER MARS 1971 SCIENCE OPERATIONAL SUPPORT EQUIPMENT Final Report
15 Nov. 1971 27 p
(Contract NAS7-100)
(NASA-CR-124763; JPL-TM-33-511) Avail: NTIS CSCL 22B

The Mariner Mars 1971 science operational support equipment (SOSE) was developed to support the checkout of the proof test model and flight spacecraft. The test objectives of the SOSE and how these objectives were implemented are discussed. Attention is focused on the computer portion of the SOSE, since incorporation of a computer in ground checkout equipment represents a major departure from the support equipment concepts previously used. A functional description of the major hardware elements contained in the SOSE is also included, along with the operational performance of the SOSE during spacecraft testing. Author

N72-13854*# General Electric Co., Philadelphia, Pa.
SPACE STATION BUILDUP SIMULATION Final Report
[1971] 9 p
(Contract NAS9-11948)
(NASA-CR-115288) Avail: NTIS CSCL 22B

Simulations of selected earth orbital operations involving the shuttle orbiter and various modular space station components are examined. Data on the physical characteristics of these items, such as size, shape, and configuration, as well as the current operational concepts were obtained from NASA, MSC and from drawings and sketches. From these data numerical models were developed for the space shuttle orbiter and components of a six-man initial station including a core module, power module with solar arrays, representative station modules, and various sensors and antenna. Also included are maintenance inspection and failure reports, discussions with operating and service personnel, and a detailed examination of the equipment. No incipient long term reliability problems were found. Author

N72-13855*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
APOLLO 14 MISSION FOOD PREPARATION UNIT LEAKAGE Anomaly Report
Aug. 1971 5 p
(NASA-TM-X-67440; Rept-1; MSC-04751) Avail: NTIS CSCL 06H

A bubble of water collected on the delivery probe of the food preparation unit after hot water was dispensed by the Apollo 14 crew. Postflight tests showed that dimensional interference between the cylinder and the piston at hot water temperatures produced the apparent leak by causing erratic and slow stroke time of the valve assembly. Author

N72-13856*# George Washington Univ., Washington, D.C.
TECHNOLOGY ASSESSMENT OF SPACE STATIONS
Vary Taylor Coates May 1971 65 p refs
(Grant NGL-09-010-030)
(NASA-CR-124795; GWPS-SDP-212) Avail: NTIS CSCL 22B

The social impacts, both beneficial and detrimental, which can be expected from a system of space stations operating over relatively long periods of time in Earth orbit, are examined. The survey is an exercise in technology assessment. It is futuristic in nature. It anticipates technological applications which are still in the planning stage, and many of the conclusions are highly speculative and for this reason controversial. Author

N72-13857*# International Business Machines Corp., Huntsville, Ala. Electronics Systems Center.
A GUIDE TO ONBOARD CHECKOUT. VOLUME 6: STRUCTURES/MECHANICS
Sep. 1971 61 p
(Contract NAS9-11189)
(NASA-CR-115255; IBM-71W-00313-Vol-6) Avail: NTIS CSCL 22B

The structures and mechanical subsystem of a space station are considered. The subsystem includes basic structure (pressurization, equipment support, meteoroid protection, radiators, insulation, and docking interfaces), the docking mechanisms, spacecraft access (hatches, airlocks, and view ports), and antenna deployment mechanisms. Checkout is discussed in terms of reliability, failure analysis, and maintenance. K.P.D.

N72-13858*# National Aeronautics and Space Administration. Manned Spacecraft Center, Houston, Tex.
APOLLO 14 MISSION: FAILURE TO ACHIEVE DOCKING PROBE CAPTURE LATCH ENGAGEMENT
Oct. 1971 23 p
(NASA-TM-X-67463; MSC-05101) Avail: NTIS CSCL 22B

Six docking attempts were required in order to successfully achieve capture latch engagement during the transposition and docking phase following translunar injection. After docking, the probe and drogue were examined by the crew. Probe operation appeared normal and radial marks were noted on the drogue. During all subsequent operations, the probe operated properly. Author

N72-13859*# Grumman Aerospace Corp., Bethpage, N.Y.
LM-12 ACTUAL WEIGHT REPORT
J. Bruno 8 Jul. 1971 38 p refs
(Contract NAS9-1100)
(NASA-CR-115294; LTR-490-214) Avail: NTIS CSCL 22B

The actual measurement by stage of LM-12 weight and center of gravity in the Y and Z plane are documented. The stages were weighed separately on the LM weight and balance fixture. The descent stage measurements were made on June 8, 1971, and the ascent stage measurements were made on June 3, 1971. The procedure for obtaining the weight and center of gravity check is defined, and the official recording of the measurements is provided. Author

N72-13860*# North American Rockwell Corp., Downey, Calif. Space Div.
SPACE SHUTTLE PHASE B EXTENSION, VOLUME 1
12 Nov. 1971 173 p
(Contract NAS9-10960)
(NASA-CR-115284; MSC-03328-Vol-1; SD-71-342-Vol-1) Avail: NTIS CSCL 22B

In order to define a system which would significantly reduce payload delivery costs, activities were extended to modifications of the reusable space shuttle design concept. Considered were systems using orbiters with external propellant tanks and an interim expendable booster which allowed phased development of the usable orbiter and booster. Analyzed were: Merits of internal and external propellant tanks and the impact of external LH2 compared to LO2 and LH2; impact of cargo bay size; impact abort; merit of expendable booster options; and merit of a phased development program. Studies showed that external LO2/LH2 and the continued use of the J-2S engine on the orbiter reduced program cost and risk. Author

N72-13861*# McGill Univ., Montreal (Quebec).
METEOROID-BUMPER INTERACTIONS PROGRAM Final Report, Sep. 1967 - Dec. 1969
P. S. Gough Nov. 1970 137 p refs
(Contract NAS3-10299)
(NASA-CR-72800; SRI-R-59) Avail: NTIS CSCL 22B

An investigation has been made of the interaction of meteoroids with shielded structures. The interaction has been simulated by the impact of Lexan cylinders onto lead shields in order to provide the vaporous debris believed to be created by meteoroid impact on a space vehicle. Shock compression data for Lexan was determined. This, in combination with the known shock compression data for the lead shield, has permitted the definition of the initial high pressure states in the impacted projectile and shield. The debris from such impact events has been permitted to interact with aluminum main walls. The walls were chosen to be sufficiently large to be effectively infinite in diameter compared to the loaded area. The thickness of the wall and the spacing from the shield were varied to determine the effect of these parameters. In addition, the effect of having a body of water behind the wall has been assessed. Measurements of the stagnation pressure in the debris cloud have been made and correlated with the response of the main wall. Author

N72-13862*# Sperry Rand Corp., Phoenix, Ariz. Flight Systems Div.
STUDY OF AUTOMATIC AND MANUAL TERMINAL GUIDANCE AND CONTROL SYSTEMS FOR SPACE SHUTTLE VEHICLES. VOLUME 2: SECTION 4 THROUGH APPENDIX B Final Report, Mar. 1970 - Mar. 1971
Stephen Osder and Roger Keller Aug. 1971 224 p refs
(Contract NAS2-5804)
(NASA-CR-114401; Rept-71-0225-02-00-Vol-2) Avail: NTIS CSCL 22B

Guidance and control design studies that were performed for three specific space shuttle candidate vehicles are described. Three types of simulation were considered. The manual control investigations and pilot evaluations of the automatic system performance is presented. Recommendations for systems and equipment, both airborne and ground-based, necessary to flight test the guidance and control concepts for shuttlecraft terminal approach and landing are reported. K.P.D.

N72-13863*# TRW Systems, Redondo Beach, Calif.
PARTICLES AND FIELDS SUBSATELLITE PROGRAM
Harry J. Horn Oct. 1971 127 p
(Contract NAS9-10800)
(NASA-CR-115299; TRW-16763-9) Avail: NTIS CSCL 22B

Developments in the Particles and Fields Lunar Subsatellite Program are reported. The basic purpose of the program is to provide three subsatellites with one for launch with Apollo 15, and one for launch with Apollo 16. At this time all three subsatellites have been completed except for a few minor changes, and the Flight 1 subsatellite has been successfully placed in orbit for the Apollo 15 CSM with all systems performing satisfactorily. The Flight 2 subsatellite is scheduled for launch on March 17, 1972. The Qualification Unit subsatellite has successfully completed its qualification testing. Author

N72-13864*# North American Rockwell Corp., Downey, Calif. Space Div.
MODULAR SPACE STATION PHASE B EXTENSION: NASA HEADQUARTERS QUARTERLY REVIEW
Earl G. Cole 31 Aug. 1971 82 p
(Contract NAS9-9953)
(NASA-CR-115320; MSC-02467; SD-71-237) Avail: NTIS CSCL 22B

Progress in the modular space station development program is reported. The space station project office organization and the manner in which the center interfaces with NR are presented along with a sortie and experiment analysis. The operations, subsystems and configurations are reviewed, and future activities are listed. F.O.S.

N72-13865*# North American Rockwell Corp., Downey, Calif. Space Div.
MODULAR SPACE STATION PHASE B EXTENSION PRELIMINARY PERFORMANCE SPECIFICATION. VOLUME 1: INITIAL STATION SYSTEMS
3 Dec. 1971 285 p
(Contract NAS9-9953)
(NASA-CR-115319; SD-71-215-1; MSC-0269) Avail: NTIS CSCL 22B

The general, operational, design/construction, and subsystem design requirements are presented for a solar powered modular space station system. While these requirements apply only to the initial station system, the system is readily adaptable to a growth configuration. Author

N72-13866*# National Aeronautics and Space Administration, Washington, D.C.
SATELLITES AT WORK (SPACE IN THE SEVENTIES)
William R. Corliss Jun. 1971 29 p Original contains color illustrations
(NASA-EP-84) Avail: NTIS; SOD $0.60 as 3300-0405 CSCL 22B

The use of satellites in the areas of communications, meteorology, geodesy, navigation, air traffic control, and earth resources technology is discussed. NASA contributions to various programs are reviewed. K.P.D.

N72-13867# Royal Observatory, Edinburgh (Scotland). Satellite Tracking Section.
STOPWATCH OBSERVATIONS OF SATELLITES, MAY 1971
R. D. Eberst May 1971 30 p
(ROE-STS-114) Avail: NTIS

Stopwatch observations made at stations during May 1971 are listed in launch and time order for each satellite. Various subtotals are given. Author (ESRO)

N72-13868# Royal Observatory, Edinburgh (Scotland). Satellite Tracking Section.
STOPWATCH OBSERVATIONS OF SATELLITES, APRIL 1971
R. D. Eberst Apr. 1971 23 p
(ROE-STS-113) Avail: NTIS

Stopwatch observations made at stations during April 1971 are listed in launch and time order for each satellite. Various subtotals are given. Author (ESRO)

N72-13869# Royal Observatory, Edinburgh (Scotland). Satellite Tracking Section.
STOPWATCH OBSERVATIONS OF SATELLITES, JULY 1971
R. D. Eberst 25 Oct. 1971 21 p
(ROE-STS-116) Avail: NTIS

Stopwatch observations made at stations during July 1971 are listed in launch and time order for each satellite. Various subtotals are given. Author (ESRO)

N72-13392*# North American Rockwell Corp., Downey, Calif.
THE APOLLO DOCKING SYSTEM
Kenneth A. Bloom and George E. Campbell *In* NASA. Goddard Space Flight Center 5th Aerospace Mech. Symp. 1971 p 3-8 (See N72-13391 04-15)
(Contract NAS9-150)
Avail: NTIS CSCL 22B

N72-13394*# Lockheed Missiles and Space Co., Sunnyvale, Calif.
AEROSPACE VEHICLE SEPARATION MECHANISMS SELECTION, DESIGN, AND USE CONSIDERATIONS
I. B. Gluckman *In* NASA. Goddard Space Flight Center 5th Aerospace Mech. Symp. 1971 p 17-23 refs (See N72-13391 04-15)
Avail: NTIS CSCL 22B

N72-13397*# Academy of Sciences (USSR), Moscow. Inst. for Machine Technology.
DOCKING-MECHANISM ATTENUATOR WITH ELECTRO-MECHANICAL DAMPER
Vladimir S. Syromyatnikov *In* NASA. Goddard Space Flight Center 5th Aerospace Mech. Symp. 1971 p 43-57 (See N72-13391 04-15)
Avail: NTIS CSCL 22B

N72-13414*# General Electric Co., Philadelphia, Pa. Missile and Space Div.
DEVELOPMENT OF PAYLOAD SUBSYSTEM-PRIMATE MISSION-BIOSATELLITE PROGRAM
James F. Hall, Jr. *In* NASA. Goddard Space Flight Center 5th Aerospace Mech. Symp. 1971 p 177-183 This paper is based on NASA-CR-73424 prepared for Ames Res. Center under contract NAS2-1900 (See N72-13391 04-15)
Avail: NTIS CSCL 22B

32 STRUCTURAL MECHANICS

Includes structural element design and weight analysis; fatigue; thermal stress; impact phenomena; vibration; flutter; inflatable structures; and structural tests. For related information see also: 17 Materials, Metallic; and 18 Materials, Nonmetallic.

N72-13870 National Lending Library for Science and Technology, Boston Spa (England).
ON THE THEORETICAL ANALYSIS OF AEROELASTICALLY INDUCED OSCILLATIONS OF CIRCULAR CYLINDRICAL STRUCTURES IN THE PRESENCE OF PERIODIC VORTEX SHEDDING
H. Foersching 22 Sep. 1971 40 p refs Transl. into ENGLISH from Z. Flugwiss (Brunswick), v. 18, no. 9/10, 1970 p 347-359 (NLL-T-6859-(5809.95)) Avail: Natl. Lending Library, Boston Spa, Engl.: 4 NLL photocopy coupons

Theoretical expressions for the analytical treatment of three-dimensional problems of the aeroelastic stability of circular cylindrical structures are presented for the range of Reynolds numbers in which periodic Karman vortex shedding takes place. The oscillation inducing generalized aerodynamic forces are formulated with the aid of experimental lift coefficients on the basis of the aerodynamic strip theory, and the oscillation problem is treated as an aeroelastic resonance problem. The validity of the mathematical relationships is verified experimentally. Author

N72-13871 National Lending Library for Science and Technology, Boston Spa (England).
BURSTING TESTS ON CYLINDRICAL STEEL MODEL CONTAINERS
P. Vierling and H. Bretfeld May 1971 19 p Transl. into ENGLISH from Tech. Mitt. Krupp (Essen), v. 27, no. 3-4, Dec. 1969 p 91-100
(NLL-M-20820-(5828.4F); NLL-T1230/ERS/71) Avail: Natl. Lending Library, Boston Spa, Engl.: 2 NLL photocopy coupons

Loading is considered for small cylindrical models of single-, double-, and triple-layered materials up to the bursting point. Tests were conducted on suitable high-value strain gages, adhesives, and facing material. A comparison of calculated and measured bursting pressures is presented. Author

N72-13872 National Lending Library for Science and Technology, Boston Spa (England).
IMPORTANCE OF THE TRUE SHAPE OF HARDNESS INDENTATIONS FOR COMPARABILITY OF VICKERS AND ROCKWELL C HARDNESS MEASURING METHODS Ph.D. Thesis
Wolfgang Weiler 22 Sep. 1971 70 p refs Transl. into ENGLISH of Carolo-Wilhelmia Tech Univ., Fac. of Mech. and Elec. Eng. Brunswick, Ph. D. thesis
(NLL-T-6873-(5809.95)) Avail: Natl. Lending Library, Boston Spa, Engl.: 7 NLL photocopy coupons

An ordered relationship between the Vickers and Rockwell C hardness measurement methods is discussed. This is clarified by a systematic investigation. For this, the following five parameters must be determined: (1) the surface of indentation, (2) the projection of the surface of indentation perpendicular to the measurement force (projection surface), (3) the deformed volume, (4) the work required for the deformation, and (5) the ratio of the work to the deformed volume. In order to preclude chance, the number of the indenter shapes must be increased. There are included in the investigations steel balls (D = 2.5 mm), as used for the Brinell hardness measurement, and conical pointed indenters (without intended rounding off) made of diamond (100, 120, 150 deg.). The measurement force is kept constant at 150 Kp. Author

N72-13873# Royal Aircraft Establishment, Farnborough (England).
MEASUREMENT OF THE NATIONAL FREQUENCIES OF THE WALLS OF BUILDINGS SENSITIVE TO SONIC BOOM
P. De Tricaud May 1971 38 p refs Transl. into ENGLISH of "Mesure des frequences propres des batiments sensibles au 'bang', Sci. and Tech. Centre on Building, Paris, report
(RAE-Lib-Trans-1589; BR26395) Avail: NTIS

A method of measuring the dynamic characteristics and natural frequencies of internal dividing walls and of window areas susceptible to sonic boom damage is described. It is shown that the results from the same type of dividing wall can vary by a large factor depending upon how the wall material is manufactured and on how the interior wall is attached to the main structure. The measured results are compared with those calculated for various types of internal walls and show a reasonable degree of agreement between calculated and measured values, provided that the physical constants of the materials are known with some accuracy. Author

N72-13874# Technische Hochschule Hannover (West Germany).
SHELL THEORY OF FINITE DEFORMATIONS AND THE CIRCULAR CYLINDRICAL SHELL WITH CIRCULAR CUTOUT AT FINITE DEFORMATIONS Ph.D. Thesis [[SCHALENTHEORIE ENDLICHER (ERFORMUNGEN UND DIE KREISZYLINDERSCHALE MIT KREISRUNDEM AUSSCHNITT BEI ENDLICHEN VERFORMUNGEN]]
Abdoul-Razzak Arour 1970 151 p refs In GERMAN
Avail: NTIS

Tensor methods are used to develop from general nonlinear shell theory a variable coordinate, geometrically nonlinear shell theory for large shifts and small distortions. Accurate results are confirmed by calculations utilizing plate equations of finite deformations, torsion shells with small deformations, and the Donell nonlinear theory for circular cylindrical shells. The described nonlinear theory is used to calculate the stress concentration in cylindrical shells having a circular cutout. Transl. by G.G.

N72-13875# Technische Hochschule Hannover (West Germany).
CONTRIBUTION TO THE THEORY OF THICK CIRCULAR CYLINDERS AND SPHERICAL SHELLS WITH INTERIOR PRESSURE Ph.D. Thesis
Zekai Celep 1971 107 p refs In GERMAN
Avail: NTIS

Elasto-plastic continuum equations are formulated and used to analyze deformation and surface displacement in axial-bound hollow cylinders and spheres that are statically loaded by dynamic internal pressure. Finite elastic deformations are described by the stress tensor and the plastic potential is used to form a linear stiffening theorem. Numerical results are presented for a material that remains isotrope and incompressible for the plastic case, as well as for the compressible or incompressible elastic case. Transl. by G.G.

N72-13876# Technische Hochschule Hannover (West Germany).
CONTRIBUTION TO CALCULATING RESIDUAL STRESS IN CONVERSION-FREE QUENCHED SOLID STEEL CYLINDERS Ph.D. Thesis
Arnulf Matting 1970 130 p refs In GERMAN
Avail: NTIS

A plastic-elastic flow model is used to analyze residual stresses produced in heated solid steel cylinders during quick quenching with water. It is shown that the developing thermal stress diffuses into the yielding boundary of the material so that inhomogeneous plastic flow occurs; thermal stress direction then reverses during cooling progress and is determined by the dimensional matrix. Transl. by G.G.

N72-13877# National Aeronautical Establishment, Ottawa (Ontario).
A CREEP BENDING ANALYSIS OF PLATES BY THE FINITE ELEMENT METHOD
T. M. Hrudey Oct. 1971 52 p refs
(NRC-12284; LR-552) Avail: NTIS

The finite element method of structural analysis was applied to the nonlinear problem of stationary creep bending of thin plates. The finite element formulation is derived from a kinematic varitational theorem analogous to the theorem of stationary potential energy. It results in a set of simultaneous nonlinear algebraic equations which are solved using the Newton-Raphson method. Author

N72-13878# Indian Inst. of Science, Bangalore. Dept. of Aeronautical Engineering.
DESIGN DATA ON BUCKLING OF CLAMPED SKEW PLATES (OBLIQUE COMPONENTS). PART 2: COMBINED LOADING
Mahabaliraja and S. Durvasula Oct. 1971 92 p refs
(AE-305-S-Pt-2) Avail: NTIS

Design data on skew plate, and numerical results for buckling coefficients of flat clamped skew plates under combined loads are presented for various combinations of skew angle and aspect ratio. The stresses are represented in terms of oblique components. The energy method is applied, expressing the deflection in terms of a double series of beam characteristic functions of a uniform clamped-clamped beam. Numerical results are presented in tables and interaction curves. Author

N72-13879# Indian Inst. of Tech., Kanpur. Dept. of Aeronautical Engineering.
FREE VIBRATION OF A SIMPLY SUPPORTED BEAM WITH NONLINEAR MATERIAL PROPERTIES
N. G. R. Iyengar and P. N. Murthy 1971 43 p refs
(AE-12/1971) Avail: NTIS

Free vibrations of a simply supported beam, with and without central mass and with nonlinear material properties, are studied. The material is of the Ramberg-Osgood type. Perturbation and finite element techniques are used to solve the governing equation. The variation of frequency with amplitude is obtained for various values of material parameters. The results indicate that the beam behaves like a soft spring for the type of nonlinearity introduced by the material. Author

N72-13880*# Lockheed Missiles and Space Co., Palo Alto, Calif. Structural Mechanics Lab.
AN EXPERIMENTAL STUDY OF THE STRENGTH AND STABILITY OF THIN MONOCOQUE SHELLS WITH REINFORCED AND UNREINFORCED RECTANGULAR CUTOUTS
Alan M. C. Holmes and Bo O. Almroth May 1971 162 p refs
(Contract NAS9-10372)
(NASA-CR-115267; LMSC-4-05-71-9) Avail: NTIS CSCL 20K

Axial compression tests were run on eleven thin-walled aluminum cylinders having rectangular cutouts. Various types of reinforcement were used around the cutouts, and some tests were run with no reinforcement. The test results are compared with the cylinder buckling loads prior to installation of the cutouts (obtained without damaging the cylinder by using a buckle-capture technique), and correlated with computer-predicted failure loads. The latter were based on the use of the STAGS computer program. For thin cylinders such as these, the test and computer-based analysis shows that for small to moderate size cutouts, reinforcement of the cutout is of no benefit unless the cylinder is of extremely high (geometrical) quality. For cylinder quality and cutout size where reinforcement is beneficial, the relative merits of the various reinforcement configurations are discussed, and an empirical basis for design is proposed. Author

N72-13881*# Syracuse Univ. Research Inst., N.Y. Dept. of Mechanical and Aerospace Engineering.
THEORETICAL STUDY OF CORRUGATED PLATES: SHEARING OF A TRAPEZOIDALLY CORRUGATED PLATE WITH TROUGH LINES PERMITTED TO CURVE
Chuan-jui Lin and Charles Libove Washington NASA Dec. 1971 163 p
(Grant NGR-33-022-115)
(NASA-CR-1750; MAE-1833-T2) Avail: NTIS CSCL 20K

A theoretical analysis is presented of the elastic shearing of a trapezoidally corrugated plate with discrete attachments at the ends of the corrugations. Numerical results on effective shear stiffness, stresses, and displacements are presented for selected geometries and end-attachment conditions. It is shown that the frame-like deformation of the cross-sections, which results from the absence of continuous end attachments, can lead to large transverse bending stresses and large reductions in shearing stiffness. Author

N72-13882# Advisory Group for Aerospace Research and Development, Paris (France).
THE ELEMENTS OF FRACTOGRAPHY
D. A. Ryder (Manchester Univ.) Nov. 1971 196 p refs
(AGARD-AG-155-71; AGARDograph-155) Avail: NTIS

This monograph is intended to serve as an introduction to 'Fractography' which may be defined as the examination of fracture surfaces at magnifications ranging from x1 to x100,000. The terminology and current ideas on fracture are introduced in an elementary account of those factors that control the mechanical properties of engineering materials. Fracture is discussed in general terms and the instruments available for fracture surface analysis are considered. The experimental and operational techniques needed in fractography are discussed with a variety of factors, especially artefacts in replicas prepared for transmission electron microscopy, that can influence the interpretation of experimental results. The application of fractography to the investigation of service failures and the use of the technique in fracture research are described. Author

N72-13883*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
THEORETICAL BUCKLING LOADS OF BORON/ALUMINUM AND GRAPHITE/RESIN FIBER COMPOSITE ANISOTROPIC PLATES
Christos C. Chamis Washington Dec. 1971 37 p refs
(NASA-TN-D-6572; E-6455) Avail: NTIS CSCL 20K

Theoretical results are presented for the buckling of anisotropic plates. The plates are subjected to simple and combined in-plane loading. The plates are made from fiber composite material of boron/aluminum or high-modulus graphite/resin. The results are presented in nondimensional form as buckling load against fiber orientation angle for various plate aspect ratios. The results indicate that buckling loads of boron/aluminum plates are independent of fiber direction if the plate aspect ratios are greater than about 1, and moderately dependent when this ratio is less than about 1. In addition, the results indicate that the buckling loads are independent of aspect ratio for plates with aspect ratios greater than about 2. Boron/aluminum composite plates can resist buckling loads more efficiently than graphite/resin composites on a specific buckling

stress basis. The numerical algorithm and a listing of the computer code used to obtain the results are included. Author

N72-13884*# Lockheed-Georgia Co., Marietta.
C-130: RESULTS OF CENTER WING RESIDUAL STRENGTH AND CRACK PROPAGATION TEST PROGRAM
F. L. Reeder, W. J. Dirkin, and H. L. Snider 15 Oct. 1971 297 p refs
(Contract NAS1-9485)
(NASA-CR-112008; ER-11178; LSR-7221-70-012A) Avail: NTIS CSCL 20K

Fourteen C-130 airplane center wings which had experienced from approximately 4,000 to 13,000 hours of flight service and its associated fatigue damage were tested to destruction, seven in upbending and seven in downbending. Six wings were tested directly for static residual strength in the fatigue-damaged condition as received from field service. The other eight wings were tested in crack propagation cyclic testing at a prescribed stress level for a maximum of 10,000 cycles. Then the stress level was reduced and testing was continued up to a maximum of 20,000 total cycles. Cyclic testing was performed with constant-amplitude stresses at a stress ratio of +0.1. Maximum cyclic skin stresses were approximately 18,000 psi. At the conclusion of cyclic testing, a static test to destruction was conducted to determine the residual strength of each fatigue-damaged specimen. Author

N72-13885# Defence Standards Labs., Maribyrnong (Australia).
SOME DEVELOPMENTS IN THE CRACK OPENING DISPLACEMENT METHOD OF ASSESSING FRACTURE TOUGHNESS
P. C. Hughes and M. E. DeMorton Oct. 1971 23 p refs
(Rept-460) Avail: NTIS

The concept and techniques for crack opening displacement testing of bend specimens are examined. The benefits of using fatigue-cracked, double notch specimens are enumerated, based on data at various temperatures and strain rates. Experiments are described which confirm the similar deformation and fracture behavior of single and double cracked specimens and indicate the extent of the elastic component of the total displacement. The character of the crack opening and the apparent center of rotation about which the crack faces hinge were determined from crack profile observations for mild steel Charpy-size specimens. Author

N72-13886# Army Materials and Mechanics Research Center, Watertown, Mass.
DYNAMIC RESPONSE OF MODERATELY THICK CIRCULAR CYLINDRICAL PANELS
Tien Yu Tsui Jul. 1971 31 p refs Backup document for AIAA Synoptic, "Dynamic Response of Moderately Thick Cylindrical Panels", scheduled for publication in AIAA Journal in May 1972
Avail: NTIS

A numerical procedure is presented for the solution of the dynamic response of a moderately thick circular cylindrical panel within the framework of the improved shell theory which includes effects of transverse shear and rotary inertia. Application was made to determine the transient response of panels to a time-varying normal load uniformly distributed over the entire surface. The results were compared with the findings based on the classical shell theory. Author

N72-13887*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AUTOMATED PRELIMINARY DESIGN OF SIMPLIFIED WING STRUCTURES TO SATISFY STRENGTH AND FLUTTER REQUIREMENTS
W. Jefferson Stroud, Cornelia B. Dexter, and Manuel Stein Washington Jan. 1972 138 p refs
(NASA-TN-D-6534; L-7876) Avail: NTIS CSCL 20K

A simple structural model of an aircraft wing is used to show the effects of strength (stress) and flutter requirements on the design of minimum-weight aircraft-wing structures. The wing is idealized as an isotropic sandwich plate with a variable cover thickness distribution and a variable depth between covers. Plate theory is used for the structural analysis, and piston theory is used for the unsteady aerodynamics in the flutter analysis. Mathematical programming techniques are used to find the minimum-weight cover thickness distribution which satisfies flutter, strength, and minimum-gage constraints. The method of solution, some sample results, and the computer program used to obtain these results are presented. The results indicate that the cover thickness distribution obtained when designing for the strength requirement alone may be quite different from the cover thickness distribution obtained when designing for either the flutter requirement alone or for both the strength and flutter requirements concurrently. This conclusion emphasizes the need for designing for both flutter and strength from the outset.
Author

N72-13888# National Aerospace Lab., Tokyo (Japan).
FULL-SCALE FATIGUE TEST OF YS-11A-500/600 TURBOPROP TRANSPORT WING. 1: SAFE-LIFE FATIGUE TEST LOADS AND TEST METHOD
Kazuyuki Takeuchi, Toshio Nohara, and Hiroo Asada Jul. 1971 23 p refs In JAPANESE; ENGLISH summary
(NAL-TR-241) Avail: NTIS

Full scale fatigue tests of the YS-11-500/600 transport aircraft wing are discussed. Tests were required because of increase in maximum takeoff weight by 2.2 tons more than original design considerations. The fatigue loads and program sequence of the tests were: (1) gust loads, maneuver loads, and ground-air-ground loads were taken into consideration as fatigue test loads and (2) flight loads corresponding to 100 flights were applied in an ascending-descending sequence in which ground-air-ground loads were inserted. Author

N72-13889# IIT Research Inst., Chicago, Ill. Shock and Vibration Information Center.
OPTIMUM SHOCK AND VIBRATION ISOLATION
Eugene Sevin and Walter D. Pilkey 1971 169 p refs
(Contract N00173-68-C)
(AD-726220; SVM-6; LC-70-608976) Avail: NTIS CSCL 13I

Contemporary approaches to the problem of optimum shock and vibration isolation design are presented. Isolation devices act to reduce the unwanted effects of shock and vibration disturbances on critical elements of a mechanical system. The problem of optimum design has to do with the selection of isolators that cause an index of the system performance to be optimized; that is, to take on a value either less or greater than that associated with other candidate isolators. In addition, the optimum design usually must satisfy constraints which are imposed on other aspects of the system response and the parameters which describe the isolators. The essential elements of the optimum design problem, in addition to a description of the system kinematics and dynamics, are: (1) the performance index, (2) the design constraints, and (3) the shock or vibration excitation.
Author

N72-13890# Lockheed Missiles and Space Co., Palo Alto, Calif.
CERTAIN EXPERIMENTAL RESULTS ON THE EFFECT OF A LATERAL SHOCK IN WATER ON A CYLINDRICAL SHELL
I. I. Anikev, M. I. Vorotnikova, and V. O. Kononenko [1971] 3 p refs Transl. into ENGLISH from Prikl. Mekh. (USSR), v. 7, no. 9, 1971 p 106-109
Avail: NTIS; National Translation Center, John Crerar Library, Chicago, Ill. 60616

Experimental results of a study of the deformation process in fiber glass and stainless steel cylindrical shells subjected to a nonstationary lateral pulse are elucidated. Author

N72-13891# Rome Univ. (Italy). School for Aerospace Engineering.
CONDITIONS FOR SPECTRAL ANALYSIS IN REAL TIME

VIBRATION TESTS [POSSIBILITA E CONDIZIONI PER L'ANALISI SPETTRALE IN TEMPO REALE NELLE PROVE DI VIBRAZIONE]
Ugo Ponzi, Roberto Ferroni, and Guido Morelli Aug. 1970 26 p refs In ITALIAN; ENGLISH summary *Its* ATTI del Centro Ric. Aerospaziali No. 30
(Rept-30) Avail: NTIS

The possibility of real time spectral analysis during the running of a vibration test of mechanical structures has been considered. The points of view of the accuracy and of the operation conditions have been investigated in order to obtain basic requirements for the instrumentation characteristics. Some specifications concerning the analysis procedure are also suggested. ESRO

N72-13892# California Univ., La Jolla. Dept. of the Aerospace and Mechanical Engineering Sciences.
CONSIDERATIONS ON THE CENTERS OF SHEAR AND OF TWIST IN THE THEORY OF BEAMS
E. Reissner and W. T. Tsai Apr. 1971 15 p refs
(Contract N00014-69-A-0200-6027; NR Proj. 064-418)
(AD-728419) Avail: NTIS CSCL 20/11

The report has two objects. One is to show that coincidence of the centers of twist and of shear may be deduced as a consequence of a reasonable formulation of the problem of torsion and flexure in the theory of beams. The other is to show that an explicit approximate determination of the location of the centers may be based on the St. Venant solutions of the torsion and flexure problems, in conjunction with a direct-methods-of-the calculus-of variations-type use of the principle of minimum complementary energy. Author (GRA)

N72-13893# California Univ., La Jolla. Dept. of the Aerospace and Mechanical Engineering Sciences.
ON ROTATIONALLY SYMMETRIC STRESS AND STRAIN IN ANISOTROPIC SHELLS OF REVOLUTION
E. Reissner and F. Y. M. Wan May 1971 9 p ref
(Contract N00014-69-A-0200-6027; NR Proj. 064-418)
(AD-728420) Avail: NTIS CSCL 20/11

The report considers a class of anisotropic, or spirally orthotropic, shells of revolution. The assumed anisotropy means a coupling of rotationally symmetric bending and twisting, where for polar orthotropic shells there is no such coupling. It is shown that the complete set of equations can once more be reduced to two simultaneous second-order differential equations, of the same type as the well-known equations for bending of the polar-orthotropic shell. Author (GRA)

N72-13894# Naval Weapons Center, China Lake, Calif.
NONDETERMINISTIC PROBLEMS IN STRUCTURAL MECHANICS
Robert T. Langland Jun. 1971 254 p refs
(AD-728402; NWC-TP-5207) Avail: NTIS CSCL 20/11

A technique for the probabilistic analysis of nondeterministic structural problems is developed. The Finite-Element Procedure is used to analyze structures whose response is a function of random variables. Estimates are obtained for the mean values and the standard deviations of the displacements and stresses. In special cases, the distribution functions of the displacements and stresses can also be obtained. The underlying random variables can be the intensity of the loads, the dimensions, and the properties of materials. The three special problems examined were one-dimensional-plane stress problems, beam-bending problems, and two-dimensional-plane strain problems. In all of these problems, the material properties were random variables. Author (GRA)

N72-13895# Naval Ship Research and Development Center, Washington, D.C.
HYDROFOIL FLUTTER ANALYSIS, USING A MODIFIED STRIP THEORY Final Report
Yuan-ning Liu and Peter K. Besch Jul. 1971 56 p refs
(NSRDC Subproj. S4606)
(AD-728406; NSRDC-3624 Task-1703) Avail: NTIS CSCL 13/10

A flutter theory based on modified Yates hydrodynamic loading was used to predict the flutter characteristics of five hydrofoil flutter models. Theoretical flutter speeds were noted when flutter was predicted to occur in a predominantly bending mode and when flutter was predicted to occur in a predominantly torsional mode. The theory may be useful for hydrofoils which are susceptible to flutter in a torsional mode. Author (GRA)

N72-13896# Notre Dame Univ., Ind. Coll. of Engineering.
MEMBRANE AND BENDING STRESSES AROUND AN ELLIPTIC HOLE IN A CYLINDRICAL SHELL
Rao M. N. Bapu, T. Ariman, and L. H. N. Lee Jul. 1971 39 p refs
(Contract N00014-68-A-0152; Themis Proj.; NR Proj. 260-112)
(AD-728409; THEMIS-UND-71-3; UND-99857) Avail: NTIS CSCL 13/13

A theoretical analysis is presented for the membrane and bending stresses around an elliptic hole in an infinitely long, thin circular cylindrical shell. The major axis of the elliptic hole is taken to be perpendicular to shell axis. The shell is loaded by a uniformly distributed bending moment around the elliptic cutout. The method of solution involves perturbation in a curvature parameter. The results obtained are valid, if the hold is small in size compared to the radius of the cylindrical shell. Expressions for the stresses at the tip of a circumferential and axial crack are also presented. GRA

N72-13897# Southwest Research Inst., San Antonio, Tex.
NONDESTRUCTIVE EVALUATION OF METAL FATIGUE Interim Scientific Report
F. N. Kusenberger, J. Lankford, Jr., P. H. Francis, and J. R. Barton Apr. 1971 115 p refs
(Contract F44620-70-C-0034; AF Proj. 9782-01; SwRI Proj. 15-2800)
(AD-728637; AFOSR-71-1965TR) Avail: NTIS CSCL 14/2

The benefit of a multi-disciplined approach to the investigation of nondestructive evaluation (NDE) techniques for the detection of fatigue damage in engineering materials is established. The results of continued fatigue crack nucleation and propagation investigations in the vicinity of inclusions in 4340 steel are presented. NDE results using ultrasonic and magnetic perturbation methods are illustrated and discussed. Certain characteristics of magnetic signals from a fatigue crack are examined with regard to the plastic zone in the vicinity of the crack. Other features of magnetic signal response from an inclusion as a function of stress cycling indicate that significant improvements in the magnetic detection of fatigue cracks appear possible. Using analytic approaches, estimates of the shape and extent of plastic yielding in the vicinity of a surface inclusion have been made and have shown qualitative agreement with metallurgical results. Important metallurgical findings related to crack initiation and propagation are also presented. Author (GRA)

N72-13898# Lockheed Missiles and Space Co., Sunnyvale, Calif.
NOSETIP DESIGN ANALYSIS AND TEST (NDAT PROGRAM), USER'S MANUAL FOR THE STAGS COMPUTER CODE, BUCKLING ANALYSIS OF GENERAL SHELLS Final Report, Jul. - Dec. 1970
F. Brogan, B. Almroth, and F. Zele 15 Dec. 1970 180 p refs
(Contract F04701-69-C-0237)
(AD-728683; LMSC-D032008; SAMSO-TR-71-95) Avail: NTIS CSCL 20/11

The report is a user's manual for STAGS, a comprehensive computer code. STAGS is intended for the static analysis of arbitrary shells including the effects of nonlinearities caused by material behavior and finite deformations. Collapse loads based on nonlinear analysis can be computed as well as buckling loads based on classical bifurcation buckling theory with linear prestress.

Arbitrary thermal and mechanical loadings can be specified. The manual provides instructions for use of the code and presents sample problems and solutions. The theoretical basis for the program also is presented. Author (GRA)

N72-13899# Carnegie-Mellon Univ., Pittsburgh, Pa. Inst. of Science.
RESEARCH IN NONLINEAR CONTINUUM MECHANICS Final Scientific Report
Bernard D. Coleman Aug. 1971 9 p refs
(Grant AF-AFOSR-1538-68; AF Proj. 9749)
(AD-728717; AFOSR-71-2251TR) Avail: NTIS CSCL 20/11

The research supported by this grant was concentrated in two areas: (I) the theory of functional-differential equations, and (II) continuum physics, with emphasis on the mechanics, thermodynamics, and optical behavior of nonlinear media with memory. For many dynamical problems involving non-linear viscoelastic materials, thermodynamical considerations supply Lyapunov functionals which can be used to investigate the stability of equilibrium points. The work done here on functional-differential equations was directed toward such dynamical problems. The research in continuum physics led to the development of a mathematical framework for the description of induced birefringence in materials with long-range memory. It was shown that for certain broad classes of motions in general isotropic materials, material symmetry and the principle of frame-indifference can be employed to simplify the relation between the history strain and dielectric properties, without invbking special hypotheses of smoothness. It was shown that for all motions of plane strain and for some motions of plane stress, general reduced formulae can be derived for quantities accessible to measurement with a plan polariscope, such as the birefringence and the inclination of the axes of refraction. A study was made of thermodynamical restrictions on electromagnetic constitutive equations. Author (GRA)

N72-13900# New York Univ., N.Y. Dept. of Aeronautics and Astronautics.
VARIATIONAL METHODS IN NONLINEAR SHELL PROBLEMS Final Scientific Report
Arnold D. Kerr Feb. 1971 18 p refs
(Grant AF-AFOSR-0813-67; AF Proj. 9768-02)
(AD-728692; NYU-AA-71-02; AFOSR-71-0073TR; Rept-61102F; Rept-681307) Avail: NTIS CSCL 20/11

The research activities under the Grant AFOSR-0813-67 are described. The conducted research is divided into three main categories: the determination of stability of elastic solids, the proper formulation of mixed problems in structural mechanics and the extension of the Kantorovich method for the solution of partial differential equations. Author (GRA)

N72-13901# George Washington Univ., Washington, D.C. Inst. for the Study of Fatigue Fracture and Structural Reliability.
FEATURES OF FATIGUE MECHANISMS CLARIFIED BY SCANNING ELECTRON MICROSCOPY
D. E. MacDonald and W. A. Wood Aug. 1971 19 p refs
(Contract N00014-67-A-0214-0011)
(AD-729088; TR-9) Avail: NTIS CSCL 20/11

It is shown how the scanning electron microscopy can extend earlier observations on the origin and development of (a) plastic fatigue, (b) elastic fatigue, and (c) ultrasonic fatigue in metals. New observations bring out especially a hot spot phenomenon, details of strain concentrations, and exceptions to the two-stage theories of crack propagation. Author (GRA)

N72-13902# Aerospace Corp., San Bernardino, Calif.
SAAS 3: FINITE ELEMENT STRESS ANALYSIS OF AXISYMMETRIC AND PLANE SOLIDS WITH DIFFERENT ORTHOTROPIC, TEMPERATURE DEPENDENT MATERIAL PROPERTIES IN TENSION AND COMPRESSION
James G. Crose and Robert M. Jones 22 Jun. 1971 325 p refs
(Contract F04701-70-C-0059)
(AD-729188; TR-0059(S6816-53)-1; SAMSO-TR-71-103) Avail: NTIS HC $6.00/MF $0.95 CSCL 20/11

The finite element method is used to determine the displacements, stresses, and strains in axisymmetric and plane solids with different orthotropic, temperature-dependent material properties in tension and compression including the effects of internal pore fluid pressures and thermal stresses. The mechanical loads can be surface pressures, surface shears, and nodal point forces as well as acceleration or angular velocity. The continuous solid is replaced by a system of elements with triangular or quadrilateral cross sections. Accordingly, the method is valid for solids which are composed of many different materials and which have complex geometry. A listing of the resulting FORTRAN IV computer program and instructions for its use are given in appendices. Two-dimensional mesh generation and temperature interpolation features allow the computer program to be readily used. The convergence of the method to exact answers with diminishing element size is demonstrated and discussed. Author (GRA)

N72-13903# Watervliet Arsenal, N.Y.
APPLICATION OF A VARIATIONAL METHOD TO DISSIPATIVE, NONCONSERVATIVE PROBLEMS OF ELASTIC STABILITY
Gary L. Anderson and Wayne W. Walter Aug. 1971 58 p refs
(DA Proj. 1F0-061102-A-35-D)
(AD-728819; WVT-7142) Avail: NTIS CSCL 20/11

The nonconservative stability problems of Beck and Leipholz, consisting of an elastic cantilevered beam subjected to a concentrated follower force acting at the free end and to a tangential force uniformly distributed along the length of the beam, respectively, are formulated with velocity-dependent internal and external damping forces included. The respective adjoint boundary value problems are derived and are used in developing variational formulations of the original boundary value problems. Because of the difficulty of solving the original problems exactly, the variational principles are used as the foundations for solving the problems approximately, the procedure being closely related to the well-known Ritz method that is applicable to nondissipative, conservative problems of elastic stability. It is found that internal damping may be either of a stabilizing or destabilizing nature, depending upon the magnitude of the external damping parameter. Author (GRA)

N72-13006*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
FATIGUE AND FRACTURE
Herbert F. Hardrath *In its* Vehicle Technol. for Civil Aviation 1971 p 209-224 refs (See N72-12995 04-02)
Avail: NTIS HC $6.00/MF $0.95 CSCL 20K

N72-13007*# National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.
AUTOMATED DESIGN METHODS IN STRUCTURAL TECHNOLOGY
Harvey G. McComb, Jr. *In its* Vehicle Technol. for Civil Aviation 1971 p 225-243 refs (See N72-12995 04-02)
Avail: NTIS HC $6.00/MF $0.95 CSCL 20K

33 THERMODYNAMICS AND COMBUSTION

Includes ablation, cooling, heating, heat transfer, thermal balance, and other thermal effects; and combustion theory. For related information see also: 12 Fluid Mechanics; and 27 Propellants.

N72-13904 National Lending Library for Science and Technology, Boston Spa (England).

THE FORMATION OF A RESIDUAL LAYER DURING THE BOILING OF LIQUID METALS IN CHANNELS

H. Kottowski 29 Jul. 1971 18 p refs Transl. into ENGLISH from Atomkernenergie (West Germany), v. 15, no. 2, 1970 p 131-137

(NLL-RISLEY-Tr-1988-(9091.9F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 2 NLL photocopy coupons

The flow behavior in the liquid and near the wall at the place of separation of the residual layer from the liquid slug was studied to understand the formation of a residual layer on the tube wall after delayed boiling. The calculations of the residual layer thickness are discussed for two limited cases of delayed boiling: low constant velocity, and uniform acceleration at any terminal velocity. The assumptions for each case are listed. The results show the existence of a liquid metal residual layer on the wall at temperatures from 800 to 1000 C during boiling experiments with K and Na, and the average thickness was determined by the evaporation time. F.O.S.

N72-13905 National Lending Library for Science and Technology, Boston Spa (England).

CALCULATING THE HEATING OF BODIES WITH VARYING COEFFICIENTS, UNDER SECOND ORDER BOUNDARY CONDITIONS

L. A. Brovkin 1971 6 p Transl. into ENGLISH from Izv. Vyssh. Ucheb. Zaved., Chern. Met. (Moscow), no. 3, 1971 p 152-154

(NLL-M-21070-(5828.4F)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

A method for determining the temperature field in a body heated by a constant flow of heat by solving the thermal conductivity equations is presented. Averaged values over the cross section of the body are substituted in the thermal conductivity equations to derive a thermal balance equation. Calculations made by the proposed method are considered to be more accurate than the generally accepted form of calculation. F.O.S.

N72-13906 National Lending Library for Science and Technology, Boston Spa (England).

MATHEMATICAL MODEL OF FLOW PATTERN AND HEAT EMISSION OF AN ENCLOSED TURBULENT DIFFUSION FLAME

R. Latsch [1971] 14 p refs Transl. into ENGLISH from Gas-Waerme (Essen), v. 20, 1971 p 106-112

(NLL-M-20813-(5828.4F); NLL-T1210/MRS/71; NLL-TNSCN-151) Avail: Natl. Lending Library, Boston Spa, Engl.: 2 NLL photocopy coupons

A mathematical model is formulated for calculating flow and mixing patterns in the heat exchange of a diffusion flame enclosed in a cylindrical combustion chamber. The laws of conservation of mass, energy, thrust, and momentum are used to determine output quantities in accordance with input quantities such as fuel composition, fuel consumption, air factor and combustion chamber dimensions. Flow and reaction patterns, temperature distribution, useful and waste heat are derived. Author

N72-13907 National Lending Library for Science and Technology, Boston Spa (England).

VELOCITY AND TEMPERATURE DISTRIBUTION IN A PLANAR LAMINAR FLAME FRONT

G. Janisch 22 Sep. 1971 11 p refs Transl. into ENGLISH from Chem.-Ing.-Tech. (Berlin), v. 43, no. 9, May 1971 p 561-565

(NLL-SMRE-Trans-6043-(8313.4)) Avail: Natl. Lending Library, Boston Spa, Engl.: 1 NLL photocopy coupon

Flow rate and temperature distribution in the planar laminar flame front of a stoichiometric methane-air mixture were measured, using the particle track method. Velocity, flame back-pressure and maximum flame temperature were determined, as well as heat flow by conduction and convection, from which the local energy conversion and the reaction rate may be calculated. Author

N72-13908# Tokyo Univ. (Japan). Inst. of Space and Aeronautical Science.

DIRECT MONTE CARLO SIMULATION OF TWO-DIMENSIONAL RADIATIVE HEAT TRANSFER IN THE ABSORBING-EMITTING MEDIUM BOUNDED BY THE NONISOTHERMAL GRAY WALLS

Masahide Murakami May 1971 44 p refs

(ISAS-463-Vol-36-No-5) Avail: NTIS

The problem of two-dimensional radiative heat exchange is numerically solved by the Monte Carlo method. The characteristics of the multidimensional radiative heat exchange, such as the existence of the maximum in the gas temperature, the discontinuities of the gas temperature and the heat flux at the wall and the occurrence of the heat flux transported along the wall are investigated systematically. Also the comparisons of the results with those by Usiskin and Sparrow and those by the diffusion approximation by Deissler are made and the applicability of the Monte Carlo method for the problem of the thermal radiation was confirmed. The approximation by Taitel was applied, accompanied by the results of the Monte Carlo method, and the characteristic of two-dimensional radiative heat exchange for the black surface case was disclosed. For the case including the gas heat generation which depends on the gas temperature, some fundamental knowledge was obtained. Author

N72-13909*# General Electric Co., Schenectady, N.Y. Research and Development Center.

SHARP FLAT PLATE HEAT TRANSFER IN HELIUM AT MACH NUMBERS OF 22.8 TO 86.8 AND IN CORNER FLOW WITH AIR AT MACH NUMBER OF 19 Final Report

H. T. Nagamatsu and R. E. Sheer, Jr. 26 Aug. 1971 63 p refs

(Contract NASw-1785)

(NASA-CR-124695) Avail: NTIS CSCL 20M

Surface heat transfer rates were measured on a sharp flat plate at zero angle of attack in a hypersonic shock tunnel. The density and leading edge Knudsen number were varied to span the continuum to near free molecule regimes. The strong interaction parameter varied from 11 to 16,000 with Knudsen numbers from 0.56 to 17.1 respectively. Local heat transfer rates in the corner flow region produced by the intersection of two perpendicular flat plates with sharp leading edges were determined for various flow densities. The strength of the shock wave from the vertical plate was varied by adjusting the angle of attack from 0 to 5 deg. The unit Reynolds number varied from 1,000 to 17,200 and the Knudsen numbers from 1.6 to 27. The strong interaction parameter varied from 14 to 500. Author

N72-13910*# Dynamic Science, Irvine, Calif.

FUNDAMENTAL IGNITION STUDY FOR MATERIAL FIRE SAFETY IMPROVEMENT, PART 1 Final Report

K. L. Paciorek and L. B. Zung 31 Aug. 1970 64 p refs

(Contract NASw-1921)

(NASA-CR-114357; T-71-01429) Avail: NTIS CSCL 21B

The investigation of preignition, ignition, and combustion characteristics of Delrin (acetate terminated polyformaldehyde) and Teflon (polytetrafluoroethylene) resins in air and oxygen are presented. The determination of ignition limits and their dependence on temperature and the oxidizing media, as well as the analyses of the volatiles produced, were studied. Tests were conducted in argon, an inert medium in which only purely pyrolytic reactions can take place, using the stagnation burner arrangement designed and constructed for this purpose. A theoretical treatment of the ignition and combination phenomena was devised. In the case of Delrin the ignition and ignition delays are apparently independent of the gas (air, oxygen) temperatures. The results indicate that hydrogen is the ignition triggering agent. Teflon ignition limits were established in oxygen only. Author

N72-13911# Technische Univ., Berlin (West Germany). Fakultaet fuer Maschinenwesen.
EFFECTS OF DIFFUSION THERMO, THERMAL DIFFUSION AND ENTHALPY TRANSPORT ON MASS AND ENERGY TRANSPORT IN BINARY MIXTURES OF LAMINAR PIPEFLOW Ph.D. Thesis [EINFLUSS VON THERMODIFFUSION, DIFFUSIONSTHERMIK UND ENTHALPIETRANSPORT AUF DEN STOFFUND ENERGIETRANSPORT IN BINAEREN GEMISCHEN BEI LAMINARER ROHRSTROEMUNG]
Lutz-Peter Roehl 1971 127 p refs In GERMAN
Avail: NTIS

The effects of thermal diffusion, diffusion kinetics, and enthalpy on the mass- and energy-transport in the laminar pipe flow of a binary gas mixture are considered. Calculated are simultaneous mass- and heat-transfer at constant temperatures and concentrations at the pipe wall, and the partial dissocuation of two gases through thermal diffusion at heat transfer with constant wall temperature. An example calculation for mass- and heat-transfer during vapor condensation in the presence of an inert gas is given. Transl. by G.G.

N72-13912# Technische Univ., Berlin (West Germany). Fakultaet fuer Maschinenwesen.
HIGH VELOCITY EFFECT ON BOILING HEAT TRANSFER Ph.D. Thesis [EINFLUSS HOHER BESCHLEUNIGUNG AWF DEN WAERMEUEBERGANG BEIM SIEDEN]
Wolf Koerner 1971 105 p refs In GERMAN
Avail: NTIS

The mechanism of heat transfer from a heated centrifuge wall to the boiling water is studied. Results show that the heat transfer takes place in a force field that is independent of the earth's velocity if centrifuge rotation is constant. Rotation number affects the separation and floating frequency of the developing bubbles on the wall. An empirical formula is developed that considers the effects of high velocity on boiling water heat transfer. Transl. by G.G.

N72-13913# Aeronautical Research Labs., Melbourne (Australia).
NATURAL CONVECTION: STATE OF THE ART
G. D. Mallinson Apr. 1971 40 p refs
(ARL/SM-Rept-330; ISBN-642-97684-8) Avail: NTIS

The characteristics of heat transfer within the cavities of aircraft structures are described. Various mathematical approaches for calculating convective heat transfer are presented. The cavities are identified as horizontal layer or vertical layer. The flow classification is described as steady, time dependent, transient, and stable. Mathematical models for various conditions of convectie heat transfer are included. Author

N72-13914*# Colorado State Univ., Fort Collins. Dept. of Electrical Engineering.
THE FEASIBILITY OF ELECTROHYDRODYNAMIC HEAT PIPES
T. B. Jones Oct. 1971 61 p refs
(Grant NGR-06-002-127)
(NASA-CR-114392; RR-1) Avail: NTIS CSCL 20M

The effect of a nonuniform electrostatic field on insulating dielectric liquids in heat pipes was studied. Topics discussed include the theory of operation, design criteria, and evaluation of optimal design features. It is concluded that the electrodynamic heat pipes offer advantages that must be weighed against the disadvantages in order to arrive at a proper assessment of their value in solving heat transfer problems. F.O.S.

N72-13915# Indian Inst. of Tech., Kanpur. Dept. of Aeronautical Engineering.
ASYMPTOTIC THEORY OF HEAT TRANSFER IN TWO DIMENSIONAL TURBULENT BOUNDARY LAYERS
Noor Afzal and Kirit S. Vajnik 1970 16 p refs
(AE-11/1970) Avail: NTIS

Heat transfer in two dimensional turbulent boundary layer flow of an incompressible fluid is studied at large Reynolds numbers. The laminar Prandtl number of the fluid is assumed to be of order unity. The analysis is based upon the under-determined system of equations and upon the idea that the flow within the boundary layer consists of two different regions. The method used is that of matched asymptotic expansions, together with the asymptotic hypotheses describing in broad terms the dominent forces and energy transfer mechanisms. As these hypotheses are not the closure hypotheses, they do not impose any relationship between the quantities determined by the mean flow and those determined by Reynolds terms. The work leads to asymptotic laws for the temperature profile corresponding to the law of the wall, the logarithmic law and the temperature defect law. Author

N72-13916*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
PASSIVE REJECTION OF HEAT FROM AN ISOTOPE HEAT SOURCE THROUGH AN OPEN DOOR
Raymond K. Burns Washington Dec. 1971 11 p refs
(NASA-TM-X-2460; E-6587) Avail: NTIS CSCL 20M

The isotope heat-source design for a Brayton power system includes a door in the thermal insulation through which the heat can be passively rejected to space when the power system is not operating. The results of an analysis to predict the heat-source surface temperature and the heat-source heat-exchanger temperature during passive heat rejection as a function of insulation door opening angle are presented. They show that for a door opening angle greater than 20 deg, the temperatures are less than the steady-state temperatures during power system operation. Author

N72-13917*# National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.
COMPUTER METHOD FOR IDENTIFICATION OF BOILER TRANSFER FUNCTIONS
Jeffrey H. Miles Washington Dec. 1971 32 p refs
(NASA-TM-X-2436; E-6485) Avail: NTIS CSCL 20M

An iterative computer method is described for identifying boiler transfer functions using frequency response data. An objective penalized performance measure and a nonlinear minimization technique are used to cause the locus of points generated by a transfer function to resemble the locus of points obtained from frequency response measurements. Different transfer functions can be tried until a satisfactory empirical transfer function to the system is found. To illustrate the method, some examples and some results from a study of a set of data consisting of measurements of the inlet impedance of a single tube forced flow boiler with inserts are given. Author

N72-13918# Bureau of Mines, Pittsburgh, Pa. Mining and Safety Research Center.
CLASSIFICATION TEST METHODS FOR FLAMMABLE SOLIDS
J. M. Kuchta and A. F. Smith 1972 16 p refs
(DOT Proj. DOT-OS-00007)
(BM-RI-7593; TN23.U7-no-7593; Dewey-7593; LC-622.06173)
Avail: NTIS

Ignition and flammability test methods were developed for use in the classification of flammable solids. A rotating disk ignition apparatus and flame spread rate apparatus are proposed for determining the ignitability and flammability of most flammable solids. Data are presented for various representative solids to show reliability of the test methods for classifying the materials. A classification system is also proposed for use in government transportation regulations. Author

N72-13919# California Univ., La Jolla. Dept. of the Aerospace and Mechanical Engineering Sciences.
ON THE DETERMINATION OF THE CENTERS OF TWIST AND OF SHEAR OF CYLINDRICAL-SHELL BEAMS
Eric Reissner and W. T. Tsai Jun. 1971 21 p refs

(Contract N00014-69-A-0200-6027; NR Proj. 064-418)
(AD-728421) Avail: NTIS CSCL 13/13

The authors have recently proposed new definitions for the centers of twist and of shear, in terms of influence coefficients for tip-loaded cantilever beams. These definitions are here applied in conjunction with a minimum complementary energy method for the approximate determination of the influence coefficients of the problem of thin-walled open and closed cross section beams, with the possibility of a continuous transition from closed cross section to open cross section. The result is an explicit formula for the coordinate of the centers of twist and of shear of beams the cross sections of which have one axis of symmetry. This formula includes as special cases the known elementary formula for open cross sections, an extension of this formula so as to include the case of flat plates, and a known formula for closed cross section thin-shell beams. Author (GRA)

N72-13920# Army Weapons Command, Rock Island, Ill. Research Development and Engineering Directorate.
CONDUCTIVE HEAT-TRANSFER RESISTANCE OF COMPOUND BARREL INTERFACE
Darrel M. Thomsen and Alexis B. Zanoico Jun. 1971 50 p
(DA Proj. 1T0-61101-A-91-A)
(AD-728811; AMSWE-RE-71-36; AMS-Code-501A.11.844) Avail: NTIS CSCL 19/6

The report is a continuation of a heat-transfer investigation performed as In-House Laboratory Independent Research to determine the effect of interface thermal-resistance on multilayer gun barrel radial temperature distributions. In previous Technical Reports 69-121 and 70-155, published under the same title, the task of establishing the feasibility of induced interface-resistance was discussed. During this reporting period, heat-transfer analysis and experimental correlation were continued. An experimental M60 gun barrel was fabricated and tested. The reduced outside barrel temperatures, of this firing test, demonstrated the effect of interface thermal resistance. Also, a significant effort was directed toward establishing fabrication techniques for a full-length thermal interface barrel.
Author (GRA)

N72-13921# Army Foreign Science and Technology Center, Charlottesville, Va.
COMBUSTION IN NARROW CAVITIES
G. P. Cherepanov 27 Jul. 1971 14 p refs Transl. into ENGLISH from Zh. Prik. Mekhan. i Techn. Fiz. (Moscow), no. 2, 1970 p 90-95
(AD-728776; FSTC-HT-23-1002-71; T702301-2301) Avail: NTIS CSCL 21/2

Solid fuel power units sometimes experience failure due to the motor exceeding its designed capacity and this leads to an explosion. One of the most frequent causes of this phenomenon are the numerous fissure like cavities, formed basically during the technological process, that are usually present in solid fuel. When the combustion front approaches the edge of such a cavity, as a result of increased pressure in the combustion chamber, the combustion quickly envelopes all of the cavity. In a sufficiently narrow and long cavity where gas encounters difficulty in escaping, the pressure in the cavity reaches such a magnitude, that the system begins to operate in a unstable manner. A theoretical description of indicated phenomena is presented. Author (GRA)

N72-13922# Army Missile Command, Redstone Arsenal, Ala. Aeroballistics Directorate.
THRUST EFFECTS ON MISSILE AERODYNAMICS
R. A. Deep, J. H. Henderson, and C. E. Brazzel 25 May 1971 40 p refs
(Contract DA Proj. 1M2-62303-A-214)
(AD-728155; RD-TR-71-9; AMCMS-Code-522C.11.21405) Avail: NTIS CSCL 21/2

Problems arising from rocket plume effects on missile aerodynamics are generally discussed. The approach taken to investigate these problems is outlined, and preliminary results are presented. Author (GRA)

N72-13923# Ohio State Univ. Research Foundation, Columbus.
AIR/WATER SPRAYS AS POTENTIAL COOLANTS FOR PIN-FINNED COLD PLATES Final Scientific Technical Report
Ian C. Finlay May 1971 37 p refs
(Contract F33615-67-C-1758; AF Proj. 7063; OSURF Proj. 2443)
(AD-729202; ARL-71-0087) Avail: NTIS CSCL 13/1

Equations are formulated which describe the processes of heat and mass transfer occurring within a pin-finned cold-plate cooled by an air/water spray. These equations are used to effect the thermal design of spray-cooled cold-plates and to study the way in which a number of the more important design variables influence the heat transfer and thermodynamic performance.
Author (GRA)

N72-13924# AeroChem Research Labs., Inc., Princeton, N.J.
MASS SPECTROMETRIC STUDY OF COMBUSTION PLASMA Annual Report, 1 Aug. 1970 - 31 Jul. 1971
William J. Miller Aug. 1971 46 p refs
(Contract N00014-71-C-0061)
(AD-729333; Aerochem-TP-265) Avail: NTIS CSCL 21/2

Several fuel-rich laminar, H2/O2/N2 flames seeded with potassium salts were employed in an investigation of the thermodynamics and kinetics of electron attachment phenomena produced by molybdenum, chromium, vanadium and boron additives. Mass spectrometry, electrostatic probes, microwave resonant cavity techniques, and optical spectroscopy are used to determine negative and positive ion identites, positive ion concentrations, electron concentrations and neutral species concentrations, respectively. It is shown that addition of molybdenum-containing compounds to flames seeded with potassium causes large reductions in concentrations of potassium atoms and extensive electron attachment. The results are interpreted in terms of a homogeneous reaction mechanism involving formation of the stable species KHMoO4, MoO3(-), and HMoO4(-), and enthalpy changes and equilibrium constants are inferred. Chromium and vanadium compounds are found to produce much smaller effects. The corresponding heat changes and equilibrium constants for the attachment reactions postulated to be responsible for observed negative ion formations are given. The kinetics of electron attachment to boron-containing species are currently under investigation. Axial concentration profiles for negative ions, electrons, H-atoms and positive ions are taken and the results interpreted in terms of a reaction rate coefficient for the process e + HBO2 yields BO2(-) + H. Author (GRA)

34 GENERAL

Includes information of a broad nature related in industrial applications and technology, and to basic research; defense aspects; information retrieval; management; law and related legal matters; and legislative hearings and documents.

N72-13925# Weizmann Inst. of Science, Rehovoth (Israel).
SCIENTIFIC ACTIVITIES, 1970
1970 413 p refs
Avail: NTIS HC $6.00/MF $0.95

Scientific work at the center of research and graduate training in the natural sciences is described. Most of the research done is fundamental in nature and relates to applied mathematics, isotopes, polymers, biophysics, organic chemistry, biochemistry, microbiology, experimental biology, and genetics. Also listed are research project grants, publications, abstracts of lectures, work done abroad and the individual scientific staff members. G.G.

N72-13926# Committee on Science and Astronautics (U. S. House).
NASA AUTHORIZATION, 1972

Washington GPO 1971 418 p Index for hearings on H.R.3981 before Comm. on Sci. and Astronautics, 92d Congr., 1st Sess.
Avail: US Capitol, House Document Room

Indexes for the hearings concerning the 1972 NASA authorizations are presented. Indexes of personal names for individuals giving testimony, and by subjects are included. F.O.S.

N72-13927# Committee on Public Works (U. S. Senate).
APPALACHIAN AIRPORTS
Washington GPO 1971 45 p ref Hearing before Comm. on Public Works, 92d Congr., 1st Sess., 2 Mar. 1971
Avail: Comm. on Public Works

A hearing before the Committee on Public Works of the United States Senate concerning the development of regional airports for improving transportation and passenger safety in the Appalachian area is presented. The airports which require improvement in terminal facilities and the types of navigation aids recommended for the airports are described. Cost estimates for completion of the safety improvement program are included. P.N.F.

N72-13928*# Mathematica, Inc., Princeton, N.J.
ECONOMIC ANALYSIS OF NEW SPACE TRANSPORTATION SYSTEMS: EXECUTIVE SUMMARY
31 May 1971 67 p ref
(Contract NASw-2081)
(NASA-CR-124767) Avail: NTIS CSCL 05C

The economic merits of three alternative space transportation systems for use in the decade of the 1980's are considered: (1) the current expendable system envisages continuing use of the types of expendable launch vehicles in the United States inventory at present; (2) the new expendable system envisages use of a new family of expendable vehicles; and (3) the Space Shuttle and Tug System. This system differs in concept from the previous systems in employing reusable rather than expendable launch vehicles. Author

N72-13929*# Mathematica, Inc., Princeton, N.J.
ECONOMIC ANALYSIS OF NEW SPACE TRANSPORTATION SYSTEMS, VOLUME 1
31 May 1971 353 p refs
(Contract NASw-2081)
(NASA-CR-124693) Avail: NTIS HC $6.00/MF $0.95 CSCL 05C

An economic analysis of three types of space transportation systems for use in the 1980 time period is presented. The three systems considered are: (1) current expendable system, (2) new expendable system, and (3) space shuttle and tug system. The costs associated with reaching initial operating capability of the three systems vary widely. The expendable systems require comparatively modest investments, but have high recurring costs. The space shuttle and tug concept requires a high initial investment, but has greatly reduced recurring costs. Author

N72-13930*# Washington Univ., St. Louis, Mo.
PROGRAM ON APPLICATION OF COMMUNICATIONS SATELLITES TO EDUCATIONAL DEVELOPMENT Progress Report
R. P. Morgan and J. P. Singh 16 Nov. 1971 176 p refs
(Grant NGL-26-008-054)
(NASA-CR-124724) Avail: NTIS CSCL 05I

Interdisciplinary research in needs analysis, communications technology studies, and systems synthesis is reported. Existing and planned educational telecommunications services are studied and library utilization of telecommunications is described. Preliminary estimates are presented of ranges of utilization of educational telecommunications services for 1975 and 1985; instructional and public television, computer-aided instruction, computing resources, and information resource sharing for various educational levels and purposes. Communications technology studies include transmission schemes for still-picture television, use of Gunn effect devices, and TV receiver front ends for direct satellite reception at 12 GHz. Two major studies in the systems synthesis project concern (1) organizational and administrative aspects of a large-scale instructional satellite system to be used with schools and (2) an analysis of future development of instructional television, with emphasis on the use of video tape recorders and cable television. A communications satellite system synthesis program developed for NASA is now operational on the university IBM 360-50 computer. Author

N72-13931# Department of Transportation, Washington, D.C.
EXECUTIVE BRANCH CRITERIA FOR DOMESTIC AIRLINE MERGER PROPOSALS
31 Aug. 1971 8 p
Avail: NTIS

Airline merger agreements should take into account the following criteria: A merger should not result in either the elimination of effective competition, or an excessive market share for the surviving firm; undue concentration within the air carrier industry; defense merger proposals by competitive carriers; substantial foreclosure of competition for interchange traffic or other excessive injury to other carriers; substantial operational, service, or organizational benefits for the surviving firm; and corrective benefits of the surviving firm towards the original difficulty of the weaker merger partner. Author

N72-13932# Committee on Appropriations (U. S. House).
DEPARTMENT OF DEFENSE APPROPRIATIONS FOR 1972. PART 6: RESEARCH, DEVELOPMENT, TEST, AND EVALUATION
Washington GPO 1971 807 p refs Hearings before Comm. on Appropriations, 92d Congr., 1st Sess.
Avail: Subcomm. on Dept. of Defense

Minutes are presented for hearings on appropriations and the 1972 budget for the Department of Defense. Research and development, testing, and evaluation were discussed. K.P.D.

N72-13933# Committee on Post Office and Civil Service (U. S. House).
CAREER PROGRAM FOR AIR TRAFFIC CONTROLLERS
Washington GPO 1971 174 p refs Hearings on H.R. 8083 and similar bills before Comm. on Post Office and Civil Serv., 92d Congr., 1st Sess., 8, 9, and 22 Jun. 1971
Avail: Comm. on Post Office and Civil Serv.

The minutes of an initial hearing on a career program for air traffic controllers are presented. A bill was proposed for maximum entrance and retention ages, training, and early retirement aspects. K.P.D.

N72-13934# Committee on Foreign Relations (U. S. Senate).
AIRCRAFT HIJACKING CONVENTION
Washington GPO 1971 102 p refs Hearings on Executive A, 92d Congr., 1st Sess. before Comm. on Foreign Relations, 7 Jun. and 20 Jul. 1971
Avail: Comm. on Foreign Relations

The minutes are presented for hearings on airplane hijacking. The convention against unlawful aircraft seizure, signed at The Hague, Netherlands, on 16 December, 1970, was discussed. K.P.D.

N72-13935# Environmental Protection Agency, Washington, D.C.
AN ADDRESS BY WILLIAM D. RUCKELSHAUS, ADMINISTRATOR, AT NATIONAL WILDLIFE FEDERATION ANNUAL MEETING, 6 MARCH 1971
William D. Ruckelshaus 6 Mar. 1971 15 p
Avail: NTIS

The federal government's position on, and goals for, correcting environmental problems are discussed. The global aspects of environmental degradation and restoration are considered as well. International environmental agreements are noted. K.P.D.

N72-13936# Naval Research Lab., Washington, D.C.
NRL PROGRESS REPORT, NOVEMBER 1971
Nov. 1971 40 p refs
Avail: NTIS

An algorithm is presented for solving fluid equations with computers. It enables users to handle large physical systems with steep gradients without false numerical smoothing terms. Other research activities in acoustics, chemistry, electronics, metallurgy, ocean science, and radar are reported. Papers by NRL staff members, appearing in current issues of scientific journals are included. F.O.S.

N72-13937# Department of Transportation, Washington, D.C. Assistant Secretary for Safety and Consumer Affairs.
GENERAL AVIATION SAFETY, VOLUME 1 Report to the Secretary
15 Sep. 1971 33 p refs
Avail: NTIS

The factors contributing to general aviation safety, with the expressed purpose of finding ways to reduce current accident rates, are examined. Data include consideration of existing regulatory policies and practices required by the FAA, organizational matters, and other matters relating to general aviation, primarily with respect to the operation of small ajrplanes. Also considered were qualifications for the general aviation pilot and flight instructor, pilot proficiency requirements, and ground support operations. Recommendations are included. E.H.W.

N72-13938*# National Aeronautics and Space Administration, Washington, D.C.
THIS IS NASA
Jun. 1971 20 p Original contains color illustrations
(NASA-EP-22) Avail: NTIS; SOD $0.60 Stock No. 3300-0396 CSCL 22A

The organization, operations, functions, and objectives of NASA are outlined. Data include manned space flights, satellite weather observations, orbiting radio relays, and new views of the earth and beyond the earth as observed by satellites. Details of NASA's work in international programs, educational training programs, and adopting space technology to earth uses are also given. E.H.W.

N72-13939*# National Aeronautics and Space Administration. Marshall Space Flight Center, Huntsville, Ala.
THE ACADEMY OF SCIENCES OF THE USSR: ANALYSIS AND COMPARISON WITH US ORGANIZATIONS
Roger M. Nicholson Aug. 1971 28 p refs
(NASA-TM-X-64629) Avail: NTIS CSCL 14B

The organization, activities, and history of the U.S.S.R. Academy of Sciences and the overall science policy, structure, and the framework of the Soviet higher educational system are dicussed in this report. Additionally, the federal science policy structure of the United States is outlined; comparison is made between the U.S.S.R. Academy of Sciences and the U.S. National Academy of Sciences. The U.S.S.R. Academy of Sciences is identified as a principal factor of policy direction in the total framework of the Soviet science policy structure. Author

N72-13940# Committee on the Judiciary (U. S. Senate).
INTERSTATE ENVIRONMENT COMPACT
Washington GPO 1971 148 p refs Hearings on S. 907 before the Comm. on the Judiciary, 92d Congr., 1st Sess., 19-20 Apr. 1971
Avail: Comm. on the Judiciary

Hearings before the Judiciary Committee on interstate environment pollution control are presented. The cooperative efforts needed by regional, local, state, and Federal Governments are cited. A coordinated program including intergovernmental cooperation for multistate action relating to protection, and participation in national programs as set forth by the Federal Government are given. E.H.W.

N72-13941# Committee on the Judiciary (U. S. Senate).
INTERSTATE ENVIRONMENT COMPACT ACT OF 1972 Report Together with Individual Views (To accompany S. 907)
Washington GPO 11 Dec. 1971 39 p refs Presented by the Comm. on the Judiciary to 92 Congr., 1st Sess., 11 Dec. 1971 (S-Rept-92-577; Calendar-556) Avail: U.S. Capitol, Senate Document Room

The recommendations by the Judiciary Committee are reported on the bill S. 907 granting advance consent by Congress to the interstate environment compact, permitting any two or more states to enter into agreements on interstate environment and pollution problems. The background, explanation of amendments, interstate compacts, and concepts of S. 907 are discussed along with air pollution, solid waste, land use, and restrictions. Passage of the bill is recommended, and a section-by-section analysis is included. F.O.S.

N72-13942# Royal Swedish Academy of Engineering Sciences, Stockholm.
DEVELOPMENTS IN RESEARCH AND TECHNOLOGY DURING 1970
1970 209 p refs In SWEDISH
(IVA-Medd-168) Avail: NTIS; Almqvist & Wiksell, Stockholm: 25 Kr

Papers on technology assessment and forecasting in modern science are presented. For individual titles, see N72-13943 through N72-13960.

N72-13943# Royal Swedish Academy of Engineering Sciences, Stockholm.
PARTICLES FASTER THAN LIGHT **c24**
In its Develop. in Res. and Technol. during 1970 1970 p 53-55 refs In SWEDISH (See N72-13942 04-34)
Avail: NTIS; Almqvist & Wiksell, Stockholm: 25 Kr

The likelihood of the existence of particles beyond the light barrier, the so-called tachyons, is discussed, with reference to Einstein's relativity theory. The feasibility of identifying these particles is theorized and techniques are indicated. The existence of particles with zero energy and infinite velocity is considered. ESRO

N72-13944# Royal Swedish Academy of Engineering Sciences, Stockholm.
NUCLEAR PHYSICS **c24**
In its Develop. in Res. and Technol. during 1970 1970 p 55-56 refs In SWEDISH (See N72-13942 04-34)
Avail: NTIS; Almqvist & Wiksell, Stockholm: 25 Kr

It has in recent years been proposed that elementary particles are composed of quarks and antiquarks. The last two years have seen a rapid development in the attempts to detect and measure the motions of these particles. This has added to the branch of chemistry involved with the synthesis of elements with atomic numbers 105 to 114, in group IV. ESRO

N72-13945# Royal Swedish Academy of Engineering Sciences, Stockholm.
HOW TO SEE AN ATOM **c24**
In its Develop. in Res. and Technol. during 1970 1970 p 56-59 refs In SWEDISH (See N72-13942 04-34)
Avail: NTIS; Almqvist & Wiksell, Stockholm: 25 Kr

How single atoms can be photographed by a scanning electron microscope is discussed. It is postulated that it is possible to see atoms in motion (the so-called atomic minuet). ESRO

N72-13946# Royal Swedish Academy of Engineering Sciences, Stockholm.
THE UTILISATION OF THE ESCA METHOD **c06**

In its Develop. in Res. and Technol. during 1970 1970
p 59-63 refs In SWEDISH (See N72-13942 04-34)
Avail: NTIS; Almqvist & Wiksell, Stockholm: 25 Kr

Studies of the electron spectroscopy method for chemical analysis (ESCA), based on recent research in Sweden, indicate that immediate practical use lies in the analysis for light elements. The method can be applied to biochemistry and the analysis of amino acids. It has proved to be useful with more complicated molecules, in modified form. A study of valence in metal carbides (charge transfer in transition metal carbides and related compounds) is discussed. ESRO

N72-13947# Royal Swedish Academy of Engineering Sciences, Stockholm.
NON-LINEAR OPTICS **c23**
In its Develop. in Res. and Technol. during 1970 1970
p 63-65 refs In SWEDISH (See N72-13942 04-34)
Avail: NTIS; Almqvist & Wiksell, Stockholm: 25 Kr

It has long been known that a number of optical phenomena are nonlinear when magnetic field strength is sufficiently high. The interaction between the field and electrical charge in materials causes a change in the optical properties, and the effect of this change cannot be observed with normal light sources. The phenomenon of overtones in laser lights is discussed, and one example of frequency summation in order to see heat is given. ESRO

N72-13948# Royal Swedish Academy of Engineering Sciences, Stockholm.
STUDIES OF FAST REACTIONS **c24**
In its Develop. in Res. and Technol. during 1970 1970
p 65-66 refs In SWEDISH (See N72-13942 04-34)
Avail: NTIS; Almqvist & Wiksell, Stockholm: 25 Kr

Measurements of ultrafast chemical reactions using laser techniques are discussed with the purpose of determining the energy, spin, and parity of the different levels in atom nuclei and elementary particles. ESRO

N72-13949# Royal Swedish Academy of Engineering Sciences, Stockholm.
PRINCIPAL DATA CALCULATIONS **c24**
In its Develop. in Res. and Technol. during 1970 1970
p 66-71 refs In SWEDISH (See N72-13942 04-34)
Avail: NTIS; Almqvist & Wiksell, Stockholm: 25 Kr

Computer programs for quantum mechanic calculations of electron states in molecules and crystal band structure are discussed. Examples of recent developments in meteorology are given. ESRO

N72-13950# Royal Swedish Academy of Engineering Sciences, Stockholm.
STUDY OF THE RESULTS OF THE MOON SHOTS **c30**
In its Develop. in Res. and Technol. during 1970 1970
p 72-81 refs In SWEDISH (See N72-13942 04-34)
Avail: NTIS; Almqvist & Wiksell, Stockholm: 25 Kr

Results of the Apollo 11 and 12 flights are discussed, emphasizing lunar geochemistry and geophysics. Measurements of the distance to the moon using laser techniques are also considered. ESRO

N72-13951# Royal Swedish Academy of Engineering Sciences, Stockholm.
EARTH MAGNETIC FIELD AND CONTINENTIAL DRIFT **c13**
In its Develop. in Res. and Technol. during 1970 1970
p 81-84 refs In SWEDISH (See N72-13942 04-34)
Avail: NTIS; Almqvist & Wiksell, Stockholm: 25 Kr

The relationship between the movement of the continents, geomagnetic polarity, and the galactic magnetic field is considered, and a theory is presented. ESRO

N72-13952# Royal Swedish Academy of Engineering Sciences, Stockholm.
NEW KNOWLEDGE OF LIFE PROCESSES **c04**
In its Develop. in Res. and Technol. during 1970 1970
p 84-92 refs In SWEDISH (See N72-13942 04-34)
Avail: NTIS; Almqvist & Wiksell, Stockholm: 25 Kr

Based upon recent developments in enzyme synthesis, the latest knowledge on genes, and particularly their isolation, synthesis, and functions, are discussed. ESRO

N72-13953# Royal Swedish Academy of Engineering Sciences, Stockholm.
EXTREME WORKING CONDITIONS **c17**
In its Develop. in Res. and Technol. during 1970 1970
p 93-97 refs In SWEDISH (See N72-13942 04-34)
Avail: NTIS; Almqvist & Wiksell, Stockholm: 25 Kr

The relationship between high temperature and high pressure deformations in materials science is discussed giving methods plastically deforming modern materials. ESRO

N72-13954# Royal Swedish Academy of Engineering Sciences, Stockholm.
COMPOSITE MATERIALS **c17**
In its Develop. in Res. and Technol. during 1970 1970
p 97-106 refs In SWEDISH (See N72-13942 04-34)
Avail: NTIS; Almqvist & Wiksell, Stockholm: 25 Kr

A process is discussed for producing and working hard metals, using cobalt as a binding material. The carbides of tungsten, titanium, tantalum, and nickel are considered. ESRO

N72-13955# Royal Swedish Academy of Engineering Sciences, Stockholm.
NEW ALLOYS **c17**
In its Develop. in Res. and Technol. during 1970 1970
p 106-108 refs In SWEDISH (See N72-13942 04-34)
Avail: NTIS; Almqvist & Wiksell, Stockholm: 25 Kr

The development of metal alloys with mechanical memory features is discussed. Emphasis is on their use in the construction industry. ESRO

N72-13956# Royal Swedish Academy of Engineering Sciences, Stockholm.
SWEDISH RESEARCH ON ENERGY AND ITS GLOBAL RELATIONSHIP **c13**
In its Develop. in Res. and Technol. during 1970 1970
p 116-150 refs In SWEDISH (See N72-13942 04-34)
Avail: NTIS; Almqvist & Wiksell, Stockholm: 25 Kr

Pollution and effects upon economics and transportation resulting from earth resource utilization in Sweden is discussed in relation to global considerations. Present-day consumption figures are given and predictions for 1980 are presented. ESRO

N72-13957# Royal Swedish Academy of Engineering Sciences, Stockholm.
EDP AND ITS UTILIZATION **c08**
In its Develop. in Res. and Technol. during 1970 1970
p 152-157 ref In SWEDISH (See N72-13942 04-34)
Avail: NTIS; Almqvist & Wiksell, Stockholm: 25 Kr

Guidelines for the development of data communication networks in banking, rail transportation, and industrial administration are given. ESRO

N72-13958# Royal Swedish Academy of Engineering Sciences, Stockholm.
NEW MEASUREMENT AND CONTROL EQUIPMENT **c14**
In its Develop. in Res. and Technol. during 1970 1970
p 157-160 refs In SWEDISH (See N72-13942 04-34)
Avail: NTIS; Almqvist & Wiksell, Stockholm: 25 Kr

The technology of electro-optical velocity measurements using X-ray photogrammetry is discussed. ESRO

N72-13959# Royal Swedish Academy of Engineering Sciences, Stockholm.
MODERN OPTICS **c23**
In its Develop. in Res. and Technol. during 1970 1970 p 160-168 refs In SWEDISH (See N72-13942 04-34)
Avail: NTIS; Almqvist & Wiksell, Stockholm: 25 Kr

Laser techniques have opened up a technology of measurement and control. Recent developments in fiber optics and acoustic holography are described. ESRO

N72-13960# Royal Swedish Academy of Engineering Sciences, Stockholm.
ENVIRONMENTAL PROBLEMS **c05**
In its Develop. in Res. and Technol. during 1970 1970 p 193-203 refs In SWEDISH (See N72-13942 04-34)
Avail: NTIS; Almqvist & Wiksell, Stockholm: 25 Kr

Swedish environmental problems are critically analyzed, in particular the use of DDT, chlorinated biphenyls, heavy metals, and plastics. Reference is made to several methods of control and legislation. ESRO

N72-13961# National Science Foundation, Washington, D.C.
GUIDE TO PROGRAMS, FISCAL YEAR 1972
1972 85 p
(NSF-71-22) Avail: SOD $0.75 as 3800-0107

Both national and special scientific research programs and projects sponsored by the National Science Foundation are discussed. A variety of research applications is described. Program listings describe the principal characteristics and basic purpose of each activity, eligibility requirements, closing dates (where applicable), and the address from which more detailed information, brochures, or application forms may be obtained. National research centers are also described. Author

N72-13962# Committee on Science and Astronautics (U. S. House).
CHAPEL OF THE ASTRONAUTS
George P. Miller Washington GPO 2 Nov. 1971 7 p Report (to accompany H.R. 11487) presented by the Comm. on Sci. and Astronaut. to the Comm. of the Whole House on the State of the Union at the 92d Congr., 1st Sess., 2 Nov. 1971
(H-Rept-92-600) Avail: US Capitol, House Document Room

The background and implementation of the bill to authorize NASA to sell a tract of land at the John F. Kennedy Space Center to the Chapel of the Astronauts, Inc., for the purpose of constructing, operating, and maintaining a public worship facility and a memorial to the astronauts are presented. A tract of 5.5 acres adjacent to the Vistor Information Center is tentatively proposed, and the restrictions imposed by NASA are outlined. N.E.N.

N72-13963# Committee on Science and Astronautics (U. S. House).
REVIEW OF RECENT LAUNCH FAILURES
Washington GPO 1971 23 p ref Presented by the Comm. on Sci. and Astronaut. at the 92d Congr., 1st Sess., Oct. 1971
Avail: Subcommittee on NASA Oversight

A report on the Atlas/Centaur failures to launch the OAO-B and Mariner 8 spacecraft into their proper trajectories is presented, and the findings and recommendations of the Centaur Quality and Workmanship Review Board are summarized. No formal statement program philosophy was found and an aggressive and creative policy for improvement of Atlas/Centaur quality and workmanship is recommended. Detailed recommendations for manufacturing and workmanship quality, test evaluation and kertification procedures, quality assurance and inspection, vendor hardware quality, and procurement practices are outlined. N.E.N.

N72-13964# Committee on Commerce (U. S. Senate).
EXTENSION OF THE HIGH-SPEED GROUND TRANSPORTATION ACT
Warren G. Magnuson Washington GPO 1971 81 p refs Report on S. 979 (as amended) presented by the Comm. on Com. at the 92d Congr., 1st Sess., 11 Jun. 1971
(Calendar-144; S-Rept-92-147) Avail: US Capitol, Senate Document Room

Statements to the committee and background material on the transportation act extension are presented, and an Excerpt from the Fourth Report on the High Speed Ground Transportation Act of 1965 is included. The Northeast Corridor transportation, advanced air cushion vehicles, advanced tube and tunneling technology, and rail technology research and development are discussed. The rail demonstrations of the New York-Washington Metroliner, and the Boston-New York Turbo train are also mentioned. N.E.N.

N72-13965# Committee on Public Works (U. S. Senate).
WATER POLLUTION CONTROL LEGISLATION, PART 1 From Subcommittee on Air and Water Pollution
Washington GPO 1971 604 p refs Hearings on S. 75, S. 192, S. 280, S. 281, S. 523, S. 601, S. 679, S. 927, S. 1011, S. 1012, S. 1013, S. 1014, S. 1015, and S. 1017 before Comm. on Public Works, 92d Congr., 1st Sess., 15-19 and 22-24 Mar. 1971
Avail: SOD $2.50

Statements and letters are presented on the Federal Water Pollution Control Act, bills to amend it, and other pending legistration pertaining to water pollution control. Analyses are given of bills to amend the pollution control act and also of the bill to establish an Environmental Financing Authority, the Marine Protection Act of 1971 to regulate such situations as ocean dumping, and the Power Plant Siting Act of 1971. Municipal waste treatment, federal grant participation, waste water treatment plant and sewer construction, and the problems involving rivers and lakes are discussed. N.E.N.

N72-13966# Committee on Public Works (U. S. Senate).
NATIONAL ENVIRONMENTAL LABORATORIES A Compilation of Comments and Materials Related to a Proposed Environmental Library
Washington GPO Jan. 1971 464 p refs Presented to the Comm. on Public Works, 92d Congr., 1st Sess., 27 Jan. 1971
Avail: Comm. on Public Works

Comments and materials related to establishing a system of National Environmental Laboratories are presented for use by the Committee on Public Works in considering S. 113. This is a bill to establish a structure that will provide integrated knowledge and understanding of the ecological, social, and technological problems associated with air pollution, water pollution, solid waste disposal, general pollution, and degradation of the environment, and other related problems. The report of the environmental study group on institutions for effective management of the environment, and environmental problems in South Florida is included. F.O.S.

N72-13967# Committee on Public Works (U. S. Senate).
WATER POLLUTION CONTROL PROGRAMS From Subcommittee on Air and Water Pollution
Washington GPO 1971 785 p refs Hearings before the Comm. on Public Works, 92d Congr., 1st Sess., 4, 8, and 9 Feb. 1971
Avail: SOD $3.25

Statements, reports, and other material on water pollution control are presented. Chemical and thermal pollutants, urban waste disposal problems, state laws and regulations, monitoring programs, industrial pollution control technology, water quality standards, research and development, program grants and ecological effects are among the topics covered. N.E.N.

N72-13968# Siemens A.G., Munich (West Germany). Daten- und Nachrichtentechnische Labs.
COMPUTER BASED INFORMATION SYSTEMS FOR DOCUMENTATION. PRELIMINARY STUDY OF THE DATA

PROCESSING PROJECT DEMONSTRATION COMPUTERIZED LITERATURE DOCUMENTATION (DEMLID) [MASCHINELLE INFORMATIONSSYSTEME FUER DIE DOKUMENTATION. VORSTUDIE ZUM DEMONSTRATIONS-DV-PROJEKT MASCHINELLE LITERATURDOKUMENTATION (DEMLID)]

Hermann Graml and Klaus Wimmer Bonn Bundeswehramt 1971 326 p refs In GERMAN; ENGLISH summary Sponsored by Bundesmin. Fuer Verteidigung
(BMVG-FBWT-71-11) Avail: NTIS HC $6.00/MF $0.95; Bundeswehramt: 25 DM

A detailed description is given of 11 operational computer-based information systems, and of 6 experimental systems. The major characteristics are mentioned of 16 other systems. An evaluation technique for determining the scope, equipment, and efficiency of the individual systems was based on a given list of criteria. The main criteria for this assessment were: (1) general information, (2) type of documents processed, (3) indexing techniques, (4) file organization, (5) retrieval techniques, (6) hardware and software, and (7) users. ESRO

N72-13969# Royal Swedish Academy of Engineering Sciences, Stockholm.

DIRECTIONS OF DEVELOPMENT IN RESEARCH AND TECHNIQUES, 1919 - 2019 [UTVECKLINGSLINJER INOM FORSKNING OCH TEKNIK 1919-2019]

1969 221 p refs In SWEDISH
(IVA-Medd-161) Avail: NTIS; Almqvist and Wiksell, Stockholm: 27 Kr

The development in modern sciences is reviewed with emphasis on the latest discoveries in quantum mechanics and quantum electrodynamics and their applications to crystal and electron structures. New thoughts on life processes are also covered, notably the synthesis of vitamins, hormones, and proteins. The integration into day-to-day life of the technological developments such as new materials and processes, computers, and modern medicine is also discussed. ESRO

N72-13970# California Univ., Los Angeles. School of Engineering and Applied Science.

A DESIGN OPTIMIZATION FOR A TWO PLAYER STRATEGIC MISSILES GAME INCORPORATING BOTH OFFENSIVE AND DEFENSIVE MISSILES

William H. Lynch Jun. 1971 111 p refs
(Contract F04701-70-C-0240; AF-AFOSR-0699-67; AF Proj. 974)
(AD-728329; UCLA-ENG-7134; AFOSR-71-2269TR) Avail: NTIS CSCL 15/7

The paper develops a technique by which a developmental planner can establish design criteria for a new weapon system which will be required to perform a specified task in the face of an opponent who has alternative means of negating the system selected. The problem is in effect a two-sided game in which one player is given the opportunity to observe the strategy of his opponent and select the most efficient response to that strategy. The objective of the study is to determine, for the player not having the advantage, that strategy which will maximize his effectiveness in the game, i.e., max-min solution. Author (GRA)

N72-13971# California Univ., Los Angeles. School of Engineering and Applied Science.

A RENDEZVOUS TECHNIQUE IN THE PRESENCE OF UNCERTAINTY

Richard S. Baty Jun. 1971 104 p refs
(Grant AF-AFOSR-0699-67; AF Proj. 9749)
(AD-728326; UCLA-ENG-7127; AFOSR-71-2267TR) Avail: NTIS CSCL 15/7

Optimal control theory and principles are employed to determine the upper limit of firing accuracy when aircraft guns are utilized against aerial targets. The optimization criterion adopted to accomplish this end consists of the minimization of the miss distance between a target and expended projectile at a specified time and also of a consideration for the amount of control expended in the process. It is assumed that there is uncertainty in the target position due to atmospheric disturbances, sensor errors, and uncertainty in the applied target control. An adaptation of Kalman filtering techniques was utilized to make a best estimate of future target position, and dynamic programming was used to determine the optimal trajectory to be flown in order to minimize the miss distance of interest. The optimal trajectory is selected by a derived optimal controller. The improvement obtained from using optimal control theory and principles is determined by comparing this method to existing aiming techniques. A recommended extension to the air/air/missile case is also incorporated. Author (GRA)

N72-13972# Air Force Logistics Command, Wright-Patterson AFB, Ohio. Packaging Evaluation Agency.

DEVELOPMENT OF CUSHIONING DATA FOR FAST PACK PROGRAM: 6 INCH X 6 INCH X 10 INCH STAR PACK Interim Report

Richard S. Larsen Jul. 1971 17 p
(AF Proj. 68-7-D-167)
(AD-728215; DSPEB-35) Avail: NTIS CSCL 13/4

The 'Star' pack design of Fast Pack containers currently being used in the Air Force Fast Pack program will provide the packaging requirement for numerous items requiring protection from shock and vibration. To insure the effective use of these 'Star' pack containers, dynamic cushioning data is required for effective and efficient selection of the optimum container. The purpose of this study is to develop dynamic cushioning curves for the six different sizes of 'Star' packs currently being used in the Fast Pack program. As a result of this study, dynamic cushioning curves are presented for a 6 inch X 6 inch X 10 inch 'Star' pack container. Author (GRA)

N72-13973# Army Missile Command, Redstone Arsenal, Ala. Aeroballistics Directorate.

LINEAR PREDICTORS FOR PREDICTED FIRE WEAPONS

Abraham H. Haddad (Illinois Univ., Urbana) 8 Mar. 1971 65 p refs
(DA Proj. 1M2-62303-A-214)
(AD-728457; RD-TR-71-5; AMCMS-Code-522C.11.21410) Avail: NTIS CSCL 19/4

The analysis of simple linear predictors for fire control of predicted-fire weapons is discussed. The performance of the predictor as a function of the intensity of the target's maneuvers and the measurement noise is considered. The predictor parameters are optimized to minimize the combined error resulting from noise and maneuvers. The ultimate objective is to employ the optimal parameter in the implementation of an adaptive predictor. Author (GRA)

N72-13974# Carnegie-Mellon Univ., Pittsburgh, Pa.

A MIXED OPTIMIZATION TECHNIQUE FOR THE GENERALIZED MACHINE REPLACEMENT PROBLEM

S. P. Sethi and T. E. Morton 1 Feb. 1971 18 p refs
(Contract N00014-67-A-0314-0007; NR Proj. 047-048)
(AD-729065; RR-241) Avail: NTIS CSCL 15/5

A mixed optimization technique for optimal machine replacement is presented which allows much more flexibility than previous models. Optimal purchase, maintenance, and sale of a given machine between any two given points in time is treated as a sub-problem, which one may choose to solve via control theory, dynamic programming, or practical engineering considerations. (A control theory formulation is used in the paper as an illustration.) These sub-problem solutions are then incorporated into a Wagner-Whitin formulation for solution of the full problem. The technique is particularly useful for problems with such asymmetries as an existing initial machine or uneven technological change. Author (GRA)

N72-13975# Army Foreign Science and Technology Center, Charlottesville, Va.

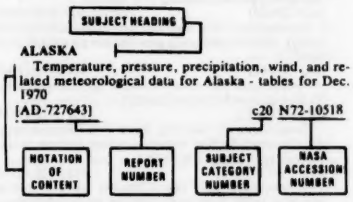
TECHNOLOGY AND ARMAMENT, NO. 4, 1971

A. Blagonravov, Yu. Gorstkin, I. Solovev, E. Vasilev, and K. Shpilev 23 Aug. 1971 133 p Transl. into ENGLISH of Tekh. i Vooruzhenie (Moscow), no. 4, 1971
(AD-729225; FSTC-HT-23-490-72; K-0093; T7023012301)
Avail: NTIS CSCL 05/2

Contents: Astronautics and the progress of science; Artilleryman's test; Improvement of dosimetry equipment; Centrifugal all-mode regulator; Submachine guns; The temperature and properties of aviation fuels; Electrification of the aircraft; The training of officers at sea; Rapid preparation of batteries; Servicing of special equipment. GRA

SUBJECT INDEX

TYPICAL SUBJECT INDEX LISTING



The subject heading is a key to the subject content of the document. The Notation of Content (NOC), rather than the title of the document, is used to provide a more exact description of the subject matter. The report number helps to indicate the type of document cited (e.g., NASA report, translation, NASA contractor report). The subject category number indicates the subject category in the abstract section in which the citation is located. The NASA accession number denotes the number by which the citation is identified within the subject category. The NOC's are arranged under each subject heading in ascending accession number order.

A

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Design and performance of bimetallic actuator for spacecraft thermal control
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[NASA-CR-124829] c30 N72-13843
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[NASA-CR-125217] c04 N72-13053
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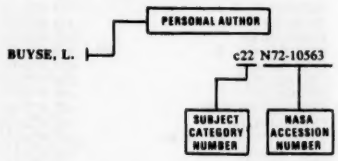

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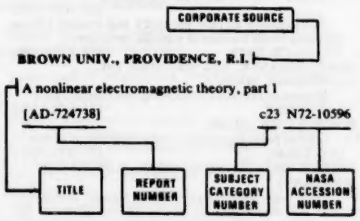

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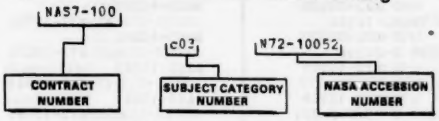

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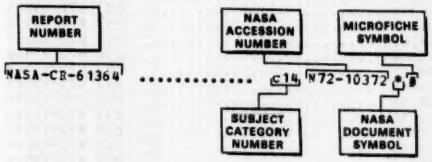

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AD-728691 ..... c13 N72-13328 #
AD-728692 ..... c32 N72-13900 #
AD-728694 ..... c19 N72-13531 #
AD-728696 ..... c20 N72-13569 #
AD-728697 ..... c08 N72-13196 #
AD-728699 ..... c09 N72-13216 #
AD-728709 ..... c26 N72-13725 #
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AD-728719 ..... c08 N72-13193 #
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LWF-71/12 ..... c23 N72-13609 #

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MSC-IN-71-FM-242 ..... c21 N72-13588*#
MSC-IN-71-FM-251 ..... c30 N72-13838*#

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NASA-CASE-MSC-12391-1 ..... c30 N72-13829*#

NASA-CASE-NPO-10817 ..... c09 N72-13206*#
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NASA-CASE-XNP-08124-2 ..... c06 N72-13102*#

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NASA-CR-125217 ..... c04 N72-13053*#
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NASA-TM-X-2442 ..... c10 N72-13224*#
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NASA-TM-X-2463 ..... c09 N72-13207*#

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NASA-TM-X-58059 ..... c29 N72-13755*#
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NASA-TM-X-62096 ..... c13 N72-13310*#
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NASA-TM-X-67470 ..... c21 N72-13588*#
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NASA-TM-X-67965 ..... c28 N72-13740*#

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NASA-TN-D-6603 ..... c14 N72-13352*#
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NASA-TN-D-6607 ..... c15 N72-13418*#
NASA-TN-D-6612 ..... c26 N72-13716*#
NASA-TN-D-6615 ..... c01 N72-12980*#
NASA-TN-D-6620 ..... c28 N72-13745*#
NASA-TN-D-6622 ..... c25 N72-13680*#

NASA-TT-F-625 ..... c30 N72-13770*#
NASA-TT-F-14060 ..... c12 N72-13273*#
NASA-TT-F-14061 ..... c04 N72-13062*#
NASA-TT-F-14067 ..... c14 N72-13371*#
NASA-TT-F-14073 ..... c01 N72-12983*#
NASA-TT-F-14074 ..... c01 N72-12982*#
NASA-TT-F-14081 ..... c16 N72-13441*#
NASA-TT-F-14087 ..... c25 N72-13682*#
NASA-TT-F-14088 ..... c06 N72-13105*#
NASA-TT-F-14090 ..... c14 N72-13370*#

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NAVSHIPS-TRANS-1244 ..... c28 N72-13751 #

NAVSHIPS-00V1 ..... c03 N72-13049 #
NAVSHIPS-00V1 ..... c13 N72-13333 #

NAVTRADEVCEN-69-C-0268-1 ..... c11 N72-13252 #

NBS-MONO-25-SECT-9 ..... c26 N72-13713 #

NBS-TN-597 ..... c09 N72-13208 #
NBS-TN-603 ..... c16 N72-13443 #
NBS-TN-702 ..... c14 N72-13368*#

NBS-9796 ..... c14 N72-13357*#

NCRE/R568 ..... c15 N72-13430 #

NELC-IR-713 ..... c07 N72-13162 #

NELC-M402 ..... c07 N72-13162 #

NELC-TR-1762 ..... c02 N72-13038 #

NHK-LABS-NOTE-135 ..... c07 N72-13142 #
NHK-LABS-NOTE-136 ..... c14 N72-13358 #
NHK-LABS-NOTE-137 ..... c14 N72-13359 #
NHK-LABS-NOTE-138 ..... c09 N72-13204 #
NHK-LABS-NOTE-139 ..... c09 N72-13205 #
NHK-LABS-NOTE-140 ..... c07 N72-13141 #
NHK-LABS-NOTE-142 ..... c14 N72-13360 #

NLL-CTO-758-(9091.9F) c23 N72-13603
NLL-CTO-766-(9091.9F) c25 N72-13671
NLL-CTO-774-(9091.9F) c25 N72-13672
NLL-CTO-782-(9091.9F) c25 N72-13670

NLL-M-20321-(5828.4F) c20 N72-13536
NLL-M-20752-(5828.4F) c30 N72-13766
NLL-M-20759-(5828.4F) c13 N72-13291
NLL-M-20761-(5828.4F) c14 N72-13344
NLL-M-20762-(5828.4F) c07 N72-13127
NLL-M-20763-(5828.4F) c20 N72-13534
NLL-M-20799-(5828.4F) c20 N72-13538
NLL-M-20800-(5828.4F) c26 N72-13707
NLL-M-20813-(5828.4F) c33 N72-13906
NLL-M-20820-(5828.4F) c32 N72-13871
NLL-M-20828-(5828.4F) c18 N72-13487
NLL-M-20839-(5828.4F) c17 N72-13464
NLL-M-20843-(5828.4F) c13 N72-13290
NLL-M-20845-(5828.4F) c14 N72-13346
NLL-M-20846-(5828.4F) c20 N72-13537
NLL-M-20852-(5828.4F) c12 N72-13256
NLL-M-20863 (5828.4F)..... c17 N72-13463
NLL-M-20868-(5828.4F) c31 N72-13849
NLL-M-20884-(5828.4F) c17 N72-13462
NLL-M-20888-(5828.4F) c30 N72-13764
NLL-M-20894-(5828.4F) c20 N72-13540
NLL-M-20895-(5828.4F) c07 N72-13128
NLL-M-20899-(5828.4F) c15 N72-13386
NLL-M-20907-(5828.4F) c12 N72-13255
NLL-M-20924-(5828.4F) c20 N72-13539
NLL-M-20929-(5828.4F) c20 N72-13541
NLL-M-20930-(5828.4F) c13 N72-13293
NLL-M-20931-(5828.4F) c20 N72-13535
NLL-M-20932-(5828.4F) c20 N72-13533
NLL-M-20938-(5828.4F) c29 N72-13752
NLL-M-20941-(5828.4F) c30 N72-13765
NLL-M-20943-(5828.4F) c06 N72-13097
NLL-M-21032-(5828.4F) c18 N72-13486
NLL-M-21033-(5828.4F) c17 N72-13460
NLL-M-21057-(5828.4F) c17 N72-13461
NLL-M-21064-(5828.4F) c17 N72-13459
NLL-M-21070-(5828.4F) c33 N72-13905

NLL-NEL-TT-2264-(6075.461) c12 N72-13257

NLL-NSTIC-TRANS-2181-(6180.59) c06 N72-13096
NLL-NSTIC-TRANS-2451-(6180.59) c13 N72-13292
NLL-NSTIC-TRANS-2499-(6180.59) c18 N72-13488

NLL-RISLEY-TR-1988-(9091.9F) c33 N72-13904

NLL-RTS-6607 ..... c09 N72-13199
NLL-RTS-6715 ..... c12 N72-13254

NLL-SNRE-TRANS-6043-(8313.4) c33 N72-13907

NLL-T-6859-(5809.95) c32 N72-13870
NLL-T-6873-(5809.95) c32 N72-13872
NLL-T-6940-(5809.95) c14 N72-13345
NLL-T-6946-(5809.95) c18 N72-13489
NLL-T-7060-(5809.95) c03 N72-13042

NLL-TNSCN-151 ..... c33 N72-13906

NLL-T1106/NRS/71 ..... c12 N72-13256
NLL-T1210/NRS/71 ..... c33 N72-13906
NLL-T1230/ERS/71 ..... c32 N72-13871
NLL-T1240/NRS/71 ..... c12 N72-13255

NLL-WH-307-(9091.9F) c12 N72-13253

NLL-117H3806/B c31 N72-13849
NLL-117H8544/B c14 N72-13344
NLL-117H8769/B c13 N72-13291
NLL-117H9109/B c30 N72-13766
NLL-1225/ERS/71 ..... c18 N72-13487
NLL-1390/71/BD c12 N72-13255

NOAA-TM-ERL-BOMAP-7 ..... c14 N72-13369 #

NOAA-TM-NWS-ER-40 ..... c20 N72-13560 #

NOTA-INTERNA-301 ..... c24 N72-13657 #
NOTA-INTERNA-303 ..... c24 N72-13658 #
NOTA-INTERNA-304 ..... c24 N72-13659 #
NOTA-INTERNA-307 ..... c24 N72-13660 #
NOTA-INTERNA-309 ..... c19 N72-13524 #
NOTA-INTERNA-315 ..... c24 N72-13661 #
NOTA-INTERNA-317 ..... c24 N72-13662 #

NP-18880 ..... c24 N72-13649 #
NP-18920 ..... c24 N72-13644 #
NP-18939 ..... c25 N72-13687 #

NPL-INS-13 ..... c15 N72-13426 #

NPS-51WU71081A ..... c20 N72-13571 #

NRC-12284 ..... c32 N72-13877 #
NRC-12288 ..... c11 N72-13232 #
NRC-12315 ..... c12 N72-13269 #

NREC-1157-1 ..... c13 N72-13331 #

NRL-MR-2284 ..... c25 N72-13705 #

NRL-77H02-26 ..... c25 N72-13705 #
NRL-7282 ..... c16 N72-13452 #

NSF-71-22 ..... c34 N72-13961 #

NSRDC-3624 TASK-1703 ..... c32 N72-13895 #
NSRDC-3645 ..... c01 N72-12986 #

NSTIC-29198/5 ..... c15 N72-13430 #
NSTIC-29678 ..... c07 N72-13163 #

NUC-TP-215 ..... c13 N72-13334 #
NUC-TP-232 ..... c11 N72-13247 #
NUC-TP-243 ..... c13 N72-13340 #

NUC-50021 ..... c13 N72-13340 #

NUSC-4083 ..... c13 N72-13333 #
NUSC-4085 ..... c03 N72-13049 #

NWC-TP-5207 ..... c32 N72-13894 #

NYO-2150-71 ..... c17 N72-13473 #
NYO-3829-67 ..... c19 N72-13521 #

NYU-AA-71-02 ..... c32 N72-13900 #

OB-6 ..... c13 N72-13314 #

OG-56 ..... c24 N72-13630*#

OWERA-TP-982 ..... c14 N72-13370*#

OWR-005 ..... c26 N72-13722 #

ORAU-113 ..... c04 N72-13063 #

ORNL-NSIC-95 ..... c24 N72-13656 #

ORNL-TM-3269 ..... c24 N72-13652 #
ORNL-TM-3429 ..... c24 N72-13653 #
ORNL-TM-3436 ..... c24 N72-13640 #
ORNL-TM-3532 ..... c25 N72-13690 #

ORNL-TR-2436 ..... c23 N72-13611 #

PA-TM-2006 ..... c14 N72-13381 #
PA-TM-2010 ..... c06 N72-13115 #
PA-TM-2011 ..... c06 N72-13126 #

PA-TR-4193 ..... c06 N72-13114 #
PA-TR-4241 ..... c08 N72-13190 #

PB-199460-D ..... c30 N72-13834*#
PB-200469 ..... c11 N72-13246 #
PB-200470 ..... c02 N72-13024 #
PB-200471 ..... c02 N72-13025 #
PB-200472 ..... c02 N72-13026 #
PB-200473 ..... c02 N72-13027 #
PB-200474 ..... c02 N72-13028 #
PB-200475 ..... c02 N72-13029 #
PB-200476 ..... c02 N72-13030 #

PB-200477 ..... c02 N72-13031 #
PB-200478 ..... c02 N72-13032 #
PB-200479 ..... c02 N72-13033 #
PB-200480 ..... c02 N72-13034 #
PB-200481 ..... c02 N72-13035 #
PB-200482 ..... c02 N72-13036 #

PIBAL-71-13 ..... c25 N72-13700 #
PIBAL-71-14 ..... c12 N72-13284 #

PR-60 ..... c04 N72-13052 #
PR-64 ..... c29 N72-13760 #
PR-77 ..... c29 N72-13754 #

PROGRAM-CODE-9E30 ..... c25 N72-13700 #

PSU-AERSP-71-4 ..... c25 N72-13678*#

PSU-IRL-SCI-376(E) ..... c14 N72-13355*#

PUBL-70-586 ..... c05 N72-13072*#
PUBL-70-586 ..... c05 N72-13072*#
PUBL-118 ..... c15 N72-13424 #

PWA-FR-4189 ..... c15 N72-13432 #

QC/R-6-046 ..... c15 N72-13389*#

QETR-11 ..... c19 N72-13526 #

QPR-1 ..... c21 N72-13580*#
QPR-1 ..... c30 N72-13769*#
QPR-2 ..... c30 N72-13828*#
QPR-102 ..... c24 N72-13667 #

R.163/SR.8 ..... c06 N72-13122 #
R.163/SR.9 ..... c06 N72-13123 #

R-25 ..... c14 N72-13374 #
R-495 ..... c10 N72-13222*#
R-502 ..... c18 N72-13499*#
R-608-ARPA ..... c16 N72-13445 #
R-892 ..... c15 N72-13435 #

RADC-TR-71-133 ..... c09 N72-13214 #
RADC-TR-71-134 ..... c19 N72-13525 #
RADC-TR-71-138 ..... c09 N72-13213 #
RADC-TR-71-144 ..... c26 N72-13718 #
RADC-TR-71-151 ..... c26 N72-13729 #
RADC-TR-71-161 ..... c14 N72-13376 #

RAE-LIB-TRAN-1415 ..... c17 N72-13472 #
RAE-LIB-TRAN-1498 ..... c04 N72-13054 #

RAE-LIB-TRANS-1545 ..... c05 N72-13079 #
RAE-LIB-TRANS-1558 ..... c14 N72-13349 #
RAE-LIB-TRANS-1566 ..... c20 N72-13557 #
RAE-LIB-TRANS-1567 ..... c31 N72-13852 #
RAE-LIB-TRANS-1589 ..... c32 N72-13873 #
RAE-LIB-TRANS-1591 ..... c02 N72-12989 #
RAE-LIB-TRANS-1596-PT-7 ..... c17 N72-13465 #

RD-TR-71-5 ..... c34 N72-13973 #
RD-TR-71-9 ..... c33 N72-13922 #
RD-TR-71-12 ..... c12 N72-13288 #

RD73 ..... c01 N72-12974 #

RE-406 ..... c01 N72-12985 #
RE-417J ..... c30 N72-13831 #

REPT-1 ..... c31 N72-13855*#
REPT-3 ..... c04 N72-13069 #
REPT-4 ..... c31 N72-13852 #
REPT-5WWTN-71-4 ..... c20 N72-13564 #
REPT-03 ..... c15 N72-13431 #
REPT-04 ..... c15 N72-13431 #
REPT-15 ..... c23 N72-13604 #
REPT-17 ..... c07 N72-13130 #
REPT-18 ..... c13 N72-13298 #
REPT-20 ..... c13 N72-13300 #
REPT-21 ..... c13 N72-13299 #
REPT-22 ..... c20 N72-13542 #
REPT-30 ..... c32 N72-13891 #
REPT-36 ..... c30 N72-13768*#
REPT-70-7 ..... c12 N72-13286 #
REPT-70-63 ..... c25 N72-13687 #
REPT-71-7 ..... c15 N72-13434 #
REPT-71-0225-01-00-VOL-1 ..... c21 N72-13585*#
REPT-71-0225-02-00-VOL-2 ..... c31 N72-13862*#
REPT-460 ..... c32 N72-13885 #
REPT-465F ..... c16 N72-13440*#
REPT-681-304 ..... c19 N72-13530 #
REPT-1285R-4 ..... c13 N72-13307 #
REPT-1545 ..... c17 N72-13473 #
REPT-6476 ..... c07 N72-13139 #
REPT-11218-F ..... c15 N72-13421*#
REPT-61102 ..... c19 N72-13531 #
REPT-61102F ..... c06 N72-13118 #
REPT-61102F ..... c06 N72-13122 #
REPT-61102F ..... c06 N72-13123 #
REPT-61102F ..... c11 N72-13250 #
REPT-61102F ..... c12 N72-13283 #
REPT-61102F ..... c17 N72-13481 #
REPT-61102F ..... c19 N72-13530 #
REPT-61102F ..... c26 N72-13727 #
REPT-61102F ..... c32 N72-13900 #
REPT-62302F ..... c06 N72-13116 #
REPT-62701D ..... c13 N72-13324 #
REPT-62701D ..... c13 N72-13337 #
REPT-004780-1-F ..... c16 N72-13438*#
REPT-026370-2-F ..... c13 N72-13324 #
REPT-036040-2-T ..... c07 N72-13174 #
REPT-056080-18-T ..... c02 N72-12991*#
REPT-681302 ..... c06 N72-13118 #
REPT-681304 ..... c19 N72-13531 #
REPT-681305 ..... c19 N72-13508*#
REPT-681306 ..... c17 N72-13481 #
REPT-681306 ..... c26 N72-13727 #
REPT-681307 ..... c06 N72-13123 #
REPT-681307 ..... c11 N72-13250 #
REPT-681307 ..... c12 N72-13283 #
REPT-681307 ..... c32 N72-13900 #
REPT-681308 ..... c06 N72-13122 #
REPT-6144501F ..... c19 N72-13508*#

RISO-237 ..... c24 N72-13651 #

RK-TR-70-18 ..... c27 N72-13738 #

RL-TR-71-3 ..... c28 N72-13748 #
RL-TR-71-8 ..... c18 N72-13500 #

RLO-2041-56 ..... c24 N72-13642 #

RM-527J ..... c16 N72-13442 #

ROE-STS-113 ..... c31 N72-13868 #
ROE-STS-114 ..... c31 N72-13867 #
ROE-STS-116 ..... c31 N72-13869 #

RPE-TR-71/2 ..... c06 N72-13108 #

RR-TR-71-8 ..... c16 N72-13454 #

RR-1 ..... c33 N72-13914*#
RR-71-3 ..... c07 N72-13138 #
RR-73/JPM2 ..... c19 N72-13511 #
RR-74/DNS-RMC-1 ..... c19 N72-13512 #
RR-75/DNS-IVB1 ..... c19 N72-13514 #
RR-76/IVB5 ..... c19 N72-13515 #
RR-80/RMC2 ..... c19 N72-13513 #
RR-81/RMC-3 ..... c19 N72-13516 #
RR-241 ..... c34 N72-13974 #
RR-710 ..... c26 N72-13708 #
RR-711 ..... c26 N72-13709 #
RR-712 ..... c08 N72-13176 #
RR-713 ..... c09 N72-13200 #

RRA-T7104 ..... c13 N72-13327 #

R71AEG248 ..... c17 N72-13468*#

S-REPT-92-147 ..... c34 N72-13964 #
S-REPT-92-577 ..... c34 N72-13941 #

S-40-1971 ..... c07 N72-13159 #
S-41-1971 ..... c07 N72-13160 #
S-42-1971 ..... c07 N72-13161 #
S-71-1076 ..... c14 N72-13383 #

SAI-RR-7003 ..... c07 N72-13175 #

SAMSO-TR-71-95 ..... c32 N72-13898 #
SAMSO-TR-71-103 ..... c32 N72-13902 #
SAMSO-TR-71-142 ..... c25 N72-13696 #
SAMSO-TR-71-143 ..... c14 N72-13375 #
SAMSO-TR-71-150 ..... c23 N72-13622 #

SAMSO-TR-71-151 ..... c24 N72-13669 #
SAMSO-TR-71-160 ..... c16 N72-13448 #

SAPR-13 ..... c26 N72-13726 #

SATR-1 ..... c14 N72-13383 #
SATR-2 ..... c13 N72-13341 #

SC-DC-713695 ..... c10 N72-13231 #
SC-DC-713706 ..... c10 N72-13228 #
SC-DC-713707 ..... c10 N72-13227 #
SC-DC-713804 ..... c10 N72-13230 #
SC-DC-714161 ..... c09 N72-13210 #

SC-DR-71-0036 ..... c14 N72-13372 #
SC-DR-710216 ..... c11 N72-13239 #

SC-R-71-3185 ..... c10 N72-13226 #
SC-R-71-3258 ..... c10 N72-13226 #

SC-RR-71-0277 ..... c12 N72-13275 #
SC-RR-710378 ..... c11 N72-13235 #

SD-71-215-1 ..... c31 N72-13865*#
SD-71-237 ..... c31 N72-13864*#
SD-71-342-VOL-1 ..... c31 N72-13860*#

SDC-TR-4771/000/00 ..... c05 N72-13089 #

SIO-31-22 ..... c13 N72-13330 #

SLAC-TRANS-132 ..... c24 N72-13639 #

SLO-PUR-856 ..... c24 N72-13642 #

SOS-DOC-7827 ..... c18 N72-13493*#

SP-71-021 ..... c19 N72-13519*#

SQUID-TR-MIT-59-PU ..... c06 N72-13125 #
SQUID-TR-MIT-60-PU ..... c06 N72-13124 #

SR-1 ..... c09 N72-13218 #
SR-1 ..... c26 N72-13725 #
SR-2 ..... c13 N72-13327 #
SR-5 ..... c13 N72-13342 #
SR-14 ..... c13 N72-13339 #

SRI-R-59 ..... c31 N72-13861*#

SSL-SER-11-ISSUE-48 ..... c30 N72-13811*#
SSL-SER-11-ISSUE-49 ..... c30 N72-13816*#
SSL-SER-11-ISSUE-50 ..... c30 N72-13817*#
SSL-SER-11-ISSUE-51 ..... c30 N72-13821*#
SSL-SER-11-ISSUE-52 ..... c30 N72-13824*#

SU-IPR-411 ..... c25 N72-13685 #

SU-SEL-71-034 ..... c19 N72-13505*#

SVM-6 ..... c32 N72-13889 #

T-71-01429 ..... c33 N72-13910*#
T-808-I-203 ..... c05 N72-13079 #

TAC-OA-TR-70-17 ..... c02 N72-13040 #

TAE-116-PT-2 ..... c11 N72-13250 #

TASK-A ..... c25 N72-13685 #

TASK-AM-B-71-PHY-41 ..... c04 N72-13061 #

TASK-SE-11-552-101-12856 ..... c03 N72-13049 #

TASK-1F162204A14608 ..... c15 N72-13435 #
TASK-1G163201-D-44701 ..... c15 N72-13433 #
TASK-1G163201D44701 ..... c15 N72-13432 #
TASK-3.2.9 ..... c08 N72-13191 #
TASK-01 ..... c04 N72-13060*#
TASK-04-01 ..... c13 N72-13339 #
TASK-160-75-01-32-10 ..... c14 N72-13348*#
TASK-0586 ..... c13 N72-13340 #
TASK-7600-02 ..... c13 N72-13339 #
TASK-61102F ..... c05 N72-13090 #
TASK-61102F ..... c13 N72-13331 #
TASK-112302 ..... c05 N72-13091 #
TASK-171003 ..... c05 N72-13087 #
TASK-681308 ..... c13 N72-13331 #

TASK-718404 ..... c05 N72-13094 #
TASK-718404 ..... c23 N72-13621 #
TASK-735106 ..... c26 N72-13723 #
TASK-735301 ..... c17 N72-13477 #

TECH-PAPER-5300-71-1 ..... c08 N72-13192 #

THEMIS-AE-71-21 ..... c28 N72-13750 #

THEMIS-AU-T-18 ..... c08 N72-13188 #

THEMIS-UND-71-3 ..... c32 N72-13896 #

TI-273-71-4 ..... c02 N72-13022 #

TM-110-196 ..... c14 N72-13361 #

TMR0115-3137 ..... c03 N72-13045*#

TM-71-1 ..... c12 N72-13263 #
TM-1971-20 ..... c09 N72-13212 #
TM-1971-29 ..... c07 N72-13164 #

TN23.07-NO-7577 ..... c30 N72-13830*#
TN23.07-NO-7587 ..... c15 N72-13423 #
TN23.07-NO-7590 ..... c06 N72-13104 #
TN23.07-NO-7593 ..... c33 N72-13918 #

TR-2 ..... c26 N72-13724 #
TR-3 ..... c26 N72-13732 #
TR-6 ..... c17 N72-13485 #
TR-7 ..... c17 N72-13479 #
TR-9 ..... c32 N72-13901 #
TR-12 ..... c02 N72-12991*#
TR-19 ..... c23 N72-13619 #
TR-20 ..... c26 N72-13719 #
TR-21 ..... c07 N72-13172 #
TR-21 ..... c26 N72-13720 #
TR-23 ..... c07 N72-13167 #
TR-27 ..... c13 N72-13301*#
TR-71-3 ..... c07 N72-13163 #
TR-71-3 ..... c07 N72-13163 #
TR-71-15 ..... c26 N72-13728 #
TR-71-826.6 ..... c16 N72-13455 #
TR-72-038 ..... c29 N72-13757*#
TR-120 ..... c26 N72-13729 #
TR-164 ..... c07 N72-13131*#
TR-168 ..... c08 N72-13185*#
TR-170 ..... c08 N72-13186*#
TR-204 ..... c07 N72-13174 #
TR-254 ..... c12 N72-13258*#
TR-760 ..... c02 N72-12993 #
TR-0059(S6816-53)-1 ..... c32 N72-13902 #
TR-0172(2220-01)-3 ..... c25 N72-13696 #
TR-0172(2220-20)-2 ..... c14 N72-13375 #
TR-0172(2250-20)-2 ..... c23 N72-13622 #
TR-0172(9230-10)-2 ..... c16 N72-13448 #
TR-0172(9260-01)-2 ..... c24 N72-13669 #
TR-6303-2 ..... c19 N72-13505*#
TR-7011-1 ..... c18 N72-13502 #

TRITA-EPP-71-06 ..... c07 N72-13158 #
TRITA-EPP-71-13 ..... c25 N72-13691 #
TRITA-EPP-71-14 ..... c13 N72-13313 #
TRITA-EPP-71-16 ..... c25 N72-13692 #
TRITA-EPP-71-19 ..... c13 N72-13321 #
TRITA-EPP-71-22 ..... c23 N72-13616 #
TRITA-EPP-71-27 ..... c23 N72-13617 #
TRITA-EPP-71-28 ..... c29 N72-13763 #
TRITA-EPP-71-29 ..... c13 N72-13317 #
TRITA-EPP-71-31 ..... c24 N72-13663 #

TRW-16416.002 ..... c05 N72-13092 #
TRW-16763-9 ..... c31 N72-13863*#

TUEP-71-47 ..... c24 N72-13633 #

T8-542-1 ..... c11 N72-13246 #
T8-542-2 ..... c02 N72-13024 #
T8-542-3-VOL-1 ..... c02 N72-13025 #
T8-542-3-VOL-2-BK-1 ..... c02 N72-13026 #
T8-542-3-VOL-2-BK-2 ..... c02 N72-13027 #
T8-542-3-VOL-2-BK-3 ..... c02 N72-13028 #
T8-542-3-VOL-2-BK-4 ..... c02 N72-13029 #
T8-542-3-VOL-3 ..... c02 N72-13030 #
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